62

Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY—BULLETIN No. 10.

SIX REPORTS

ON THE

GEOLOGICAL FEATURES OF PART OF THE DISTRICT TO BE TRAVERSED BY THE PROPOSED TRANSCONTINENTAL RAILWAY.

BY

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GOVERNMENT GEOLOGIST.

Reprinted, with Notes and Additions, and issued under the Authority of the Hon. Robert Philp, Minister for Mines, from a Parliamentary Paper issued in 1885.

WITH TWO MAPS.

BRISBANE:

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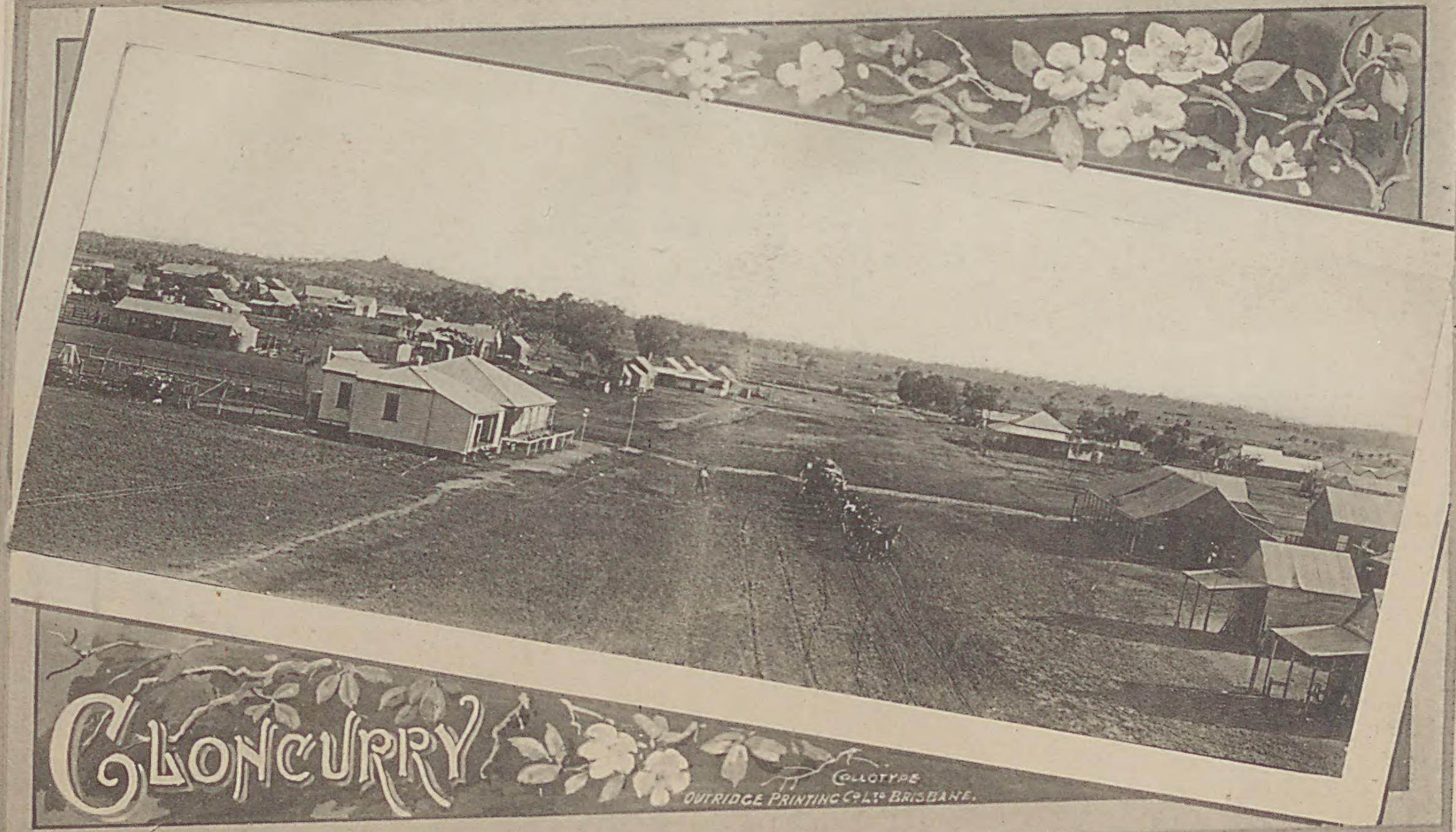
1898

"Gilded Rose"
Gold Mine.
Mount Leviathan
or
Black Mountain
Ironstone
Outcrop
of
Copper Lode "Great Australia" Cloncurry
Outridge Printing Co Ltd Brisbane Collotype


GLONCURRY
COLLOTYPE
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PREFACE.

The following reports, written in 1881-2, deal chiefly with the Western Downs and the Cloncurry and Leichhardt districts. They have for some time been out of print, and as much inconvenience has resulted the Honourable The Minister for Mines has directed that they should be reprinted.

It would obviously be injudicious to reprint the reports *verbatim* without reference to the light which has been thrown on many of the questions referred to by more recent investigations. I have accordingly, without altering the text, beyond correcting typographical errors,* added, in the form of footnotes, some further information.

Three maps accompanied the Report, which was originally issued as a Parliamentary Paper: No. 1, a map of Cloncurry on the scale of half-an-inch to the mile; No. 2, a map, on the scale of four miles to an inch, of the district between the Gregory and Dugald Rivers; and No. 3, a map, on the scale of sixteen miles to an inch, of the district between Hughenden and the Gregory River. Map No. 3 is not reproduced with the present issue, as it is believed that the route described will be more easily followed on the sixteen mile map of the colony issued by the Surveyor-General's Department, of which the topography is more correct than in the maps available in 1881. For the same reason map No. 2 is only reproduced as regards the part where copper and other mines are laid down. Maps Nos. 1 and 2 are reduced to half the scale.

R. L. J.

Geological Survey Office,
Brisbane, 16th August, 1898.

* I had no opportunity of revising a proof of the Parliamentary Paper, and several errors were allowed to pass in consequence.—R.L.J.

FIRST REPORT.

Cloncurry, 12th October, 1881.

To Major-General The Hon. W. Feilding.

Sir,

Having received instructions from the Hon. the Colonial Treasurer to join the Transcontinental Railway Survey Party at Cloncurry township, on 10th September, and there to place myself under your direction, I left Townsville on the 26th August, and reached Cloncurry, a distance of 558 miles, on the 20th September. My start was delayed for ten days by an accident which I sustained while riding out to purchase horses for the journey, but I was still in time to join you, as you only arrived on 7th instant.

The following notes embody my observations—(1) on the journey, (2) on excursions made from Cloncurry as a centre while waiting for you, and (3) on excursions made in your company.

The district to be described is included in sheets 2 and 4 of the new map of Queensland, on the scale of 16 miles to the inch.

It will be readily understood that my opinions on points of geological theory may be modified by further evidence in the course of the investigation which is still going on.

In view of a possible junction of the Transcontinental Railway with the line which is now nearly completed to the Charters Towers Goldfield, and the further extension of which to Hughenden has recently (as I learn) been authorised by Parliament,* my notes on the journey from Hughenden down the valley of the Flinders to the Cloncurry may possess some interest for the Syndicate. Moreover, it is quite possible that the evidence bearing on geological questions of commercial importance, relating to the district to be traversed by the proposed railway, may be looked for and found in distant parts of the colony.

The granite range, dividing the Burdekin from the Flinders, is crossed by the Hughenden road, at an elevation of 3,040 feet above the sea level. It is flanked by a deposit of basaltic lava, in nearly horizontal beds, which extend to Dalrymple on the east, and to Tattoo Camp, seven miles above Wongalee Station (1,840 feet) on the west. Here a gully cuts through the lowest bed of basalt, and exposes about 50 feet of the underlying "Desert Sandstone." The sandstone is of the usual type, white or yellowish, with false-bedding, and with soft ferruginous portions, apt to weather into caverns. The only fossils observed were some twig-impressions. Spinifex grass at once takes possession of the soil where the Desert Sandstone comes to the surface. It, however, covers on the Hughenden road only a narrow belt of country.

*The railway to Hughenden has long ago been completed, and is now being extended to Winton, R.L.J., August, 1898.

The basalt occurs in outlying table-mountains between Porcupine Creek and the Flinders, as far as Mount Beckford, and in all probability once covered a great part of the downs.

Twelve miles from Hughenden, a gully, rising in Mount Beckford and falling into Porcupine Creek, exposes a section of about 12 feet of horizontally-bedded grey clay shales (or "blaes" in the language of the coal miner), with thin bands of grey flags and "damper"-shaped nodules of magnesian limestone, each enclosed in an envelope of glittering carbonate of lime. This is the first section of the strata which underlie the Desert Sandstone, and which have been determined, from the fossils collected by Daintree, to be of Cretaceous age.

Similar strata are exposed at Hughenden, in the Chinaman's Gully, and at the washpool from which Daintree obtained some of his fossils. I could see, however, only a few belemnites and some shells, all in bad preservation.

Hughenden, 1,600 feet above the sea level, situated on the left bank of the Flinders, is a thriving little township which has sprung into new life within the last three years, chiefly owing to the stocking with sheep of the stations on the Flinders and Diamentina. It possesses a court-house, a post-office, a forge, three hotels, a bakery, three general stores, two saddleries, a bank, and a number of private residences. Since the date of my visit, Hughenden has been connected by telegraph with Charters Towers and the Cape Diggings. When the township becomes the terminus of the Townsville Railway, it will supply the sheep stations of the west, and enable them to send their wool to the coast without crossing the stony basalt country and the formidable coast range. I could form some idea of the extent of this traffic, which is yet in its infancy, from the number of waggons met with between Townsville and Hughenden, each groaning under its load (3 or 4 tons) of wool bales. Carriage by dray, for 500 or 600 miles, it is needless to say, is very expensive. The loads are on the road for months, and each dray involves the employment of a score of bullocks, or an equivalent number of horses.*

The Flinders, at Hughenden, has a sandy bed, 200 yards wide Eighty miles down the river, at Richmond Downs, it is only 30 yards in width.

The Cloncurry road hugs the left bank of the Flinders, as far as it is possible, viz., to near the mouth of Neelia Creek, going considerably more to the North than is necessary. The object of this deviation is to get water for camping purposes; and water can be found at all seasons—either in holes in the river bed or in ana-branches.

The road passes Telemon and Marathon Stations; and at Richmond Downs, 83 miles from Hughenden, may be seen the rudiments of a township. Besides Messrs. Bundock and Hays' head station, there are a Chinaman's garden, store, public-house, and post-office. Here the road branches off to Cambridge Downs sheep station, the Upper Saxby, and the Woolgar Goldfield. The latter, which was only discovered in 1879, is already rising in importance as a reefing district. Thirty-nine miles below Richmond Downs is Low's public-house and store. From Low's to the crossing of Neelia Creek is a distance of 40 miles; thence to Julia Creek, an affluent of the Cloncurry River, is 25 miles—without water in the dry

* The aspect of the traffic has been completely altered since the completion of the railway, and the town of Hughenden now differs widely from the township above described. R.L.J., 1898.

season. (Julia Creek is incorrectly located on the map.) The creek has a fine waterhole at the crossing of the road. Eddington Station is 12 miles further, on Eastern Creek, which has also large permanent waterholes.

Eight miles SW. of Eddington Station the Gilliat River is crossed. Water is to be found in each of its tributaries, viz., Gidya Creek (4 miles); Holy Joe's Creek (6 miles); and Box Creek (4 miles). These creeks are not shewn in the map.* Ten miles from the creek last named is the Fullarton River, on which Messrs. Nesbit and McEacharn are forming a new station named Strathfield; thence to the Williams River is a distance of 16 miles. (Water.) Fourteen miles from the Williams, at the first crossing of Fisher's Creek, a tributary of the Williams, the "rolling downs" come to an end, and auriferous and cupriferous country begins. In 10 miles more, Fisher's Creek is again crossed near its head. Here there are two wells, and the "Queensland" quartz crushing machine. The township of Cloncurry is about 12 miles distant from the wells.

The "rolling downs" extend from Wongalee to Fisher's Creek. They are well grassed, mainly with the nutritious Mitchell grass, but singularly bare of timber. When a line of trees is seen in the distance, it may safely be presumed to mark a watercourse or chain of lagoons—more likely to be dry than not. The soil is excellent, being derived (except in alluvial bottoms) from the waste of shales, sandstones, and limestones, with a happy mixture of the debris of the denuded basaltic tableland. It is capable of being turned to good account for agricultural purposes, if water can be made available. At present its pastures support sheep and cattle in numbers which, though immense, still come far short of their capacity.

Without entering fully into the geological age of the downs, I may mention that I believe the strata to form one continuous series representing part of the Cretaceous and Oolitic formations.† Apparently they form from east to west a large synclinal trough, with an axis crossing the Flinders in the neighbourhood of Marathon. At the heads of the Flinders the lowest beds do not crop out, as they overlap the palæozoic and metamorphic rocks of the dividing range, and are covered by the basalt of the tableland. To the west of Richmond Downs, however, a gentle dip to the east brings up to the surface a series of strata which apparently occupy a lower horizon than those in the centre of the trough.‡ From Hughenden to Marathon the strata consist for the greater part of grey shales, with nodules of magnesian limestone, and grey and brown sandstones, which are occasionally calcareous and nodular. Near Richmond Downs, where an easterly dip is for the first time distinctly observable, the limestones take a different character, and are distinguished by a prevalent cone-in-cone structure. Further west there are fewer shale beds, and thicker and browner sandstones. The latter are extensively veined with gypsum; and I have been informed by squatters and others, that *beds* of gypsum are frequently met with in sinking wells. The whole series is fossiliferous. I should not be surprised if the strata west of Richmond Downs should be pronounced on palæontological evidence to be of older date than those to the east, although some of the fossils are common to the whole series. It is, however, premature to speculate on the question till the fossils which I

* They are now shewn. R.L.J., 1898.

† They are now regarded, on palæontological evidence, as Lower Cretaceous. R.L.J., 1898.

‡ Since the above was written, the evidence derived from bores for artesian water points to a general, though undulating, dip to the West, with a rise of the lower strata towards the palæozoic mass of Cloncurry and the Georgina. R.L.J., 1898.

have collected shall have been worked over by a palæontologist. My friend and late colleague, Mr. Robert Etheridge, junior, of the British Museum, will probably undertake this task, for which his previous labours in Australian palæontology peculiarly qualify him.

Near Fisher's Creek, where the "downs" beds abut on the metamorphic rocks of the Cloncurry district, the strata are upturned and altered, the limestones becoming crystalline and the sandstones assuming the character of hard quartzites. Even in the crystalline limestones, however, some fossils were obtained in a state of exquisite preservation.

At intervals to the west of Hughenden, the Desert Sandstone occurs in isolated table-mountains capping the strata of the downs. Notable among these are Mount Walker, between the Flinders and Walker's Creek, a table-land between Porcupine and Betts' Gorge Creek, and two table-mountains between the Flinders and the Dutton. Another outlier of the same sandstone rests on gneiss between Mount Leviathan and Chinaman's Creek, on the left bank of the Cloncurry. Others occur, I believe, resting on metamorphic rocks, in the neighbourhood of the Soldier's Cap, although I have as yet only seen that locality from a distance. There can be little doubt that the Desert Sandstone formerly extended over the length and breadth of the downs.

Two questions of the utmost importance arise with reference to the "downs" strata, viz.: the supply of water and coal.

To convert the pastoral downs into rich agricultural country (for which the soil is admirably suited) would enhance the market value of the land to an extent which I hesitate to express in figures. This conversion, however, is only possible through a comprehensive system of water-raising and distribution, which would permit of systematic irrigation. Wells would have to be sunk under the direction of a competent hydraulic engineer; the land to be disposed of would have to be portioned out in suitable water districts; and the agricultural settlers would have to purchase or rent their water privileges. If my theory, that the downs strata form a great synclinal trough, be correct, we may expect to find the greater part of the drainage of the dividing range between the Flinders and the Burdekin, and of the McKinlay Ranges, lodged in the more pervious beds of the series, under conditions favourable for artesian wells.† It will be necessary, however, to investigate the geological structure of the downs much more minutely than I have been able to do, before a reliable opinion can be arrived at on this point.

The other question—that of the existence of coal under the downs—is of no less importance. Coal seams have been discovered in wells at Tambo, Aramac, Vindex, and Winton, at no great depth below the superficial "Cretaceous" strata of the downs.‡ I observe with pleasure that the terms of your instructions will give me an opportunity of visiting

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* Now Curator of the Australian Museum, Sydney. It is mainly through Mr. Etheridge's determinations that the Lower Cretaceous age of the "Rolling Downs" formation has been established. See "Geology and Palæontology of Queensland and New Guinea," by Jack and Etheridge. Brisbane and London, 1892. R.L.J., 1898.

† Since the above was written, the condition of the Western downs has been greatly altered and improved by the success of bores in search of artesian water. R.L.J., 1898.

‡ The artesian bores have added to the above list, Lammermoor, Hughenden, Prairie, Winton, (Bore), Darr River Downs, Mulga Downs, Redcliffe (ughenden), Glenariffe, Dillallah, Aberfoyle, Tara, Barcaldine Downs, Burenda, Dunraven, Warreah, &c., but the question of the age of the coal is not yet settled. It may, in whole or in part, belong to the "Trias-Jura" or Ipswich Coal Measures, judging from evidence obtained in New South Wales. The Cretaceous (Lower Cretaceous) rocks can no longer be described as "superficial," as some of the bores prove them to attain a thickness of over 4,000 feet. R.L.J., 1898.

some of these localities, when I hope to find out something definite regarding the age of the coal. If, on the one hand, the coal seams are truly interstratified with the "Cretaceous" rocks, there will be every reason to believe that they extend over an immense area beneath the downs. On the other hand, if, at the localities referred to, the "Cretaceous" strata overlie unconformably the palæozoic coal measures of Newcastle and the Bowen River, we can rest assured of the existence, under the proposed line of railway, of immense stores of coal, regarding which we already know something definite, and which are of proved value.

It now only remains for me to add a few notes on the metalliferous district in the centre of which you are now camped. The details must be reserved till my survey has been completed, as I expect to spend some little time here on my return from the North.

From Cloncurry as a centre, my travels have extended (while waiting for your arrival) north-westward to the Dugald River (45 miles), southward up the Cloncurry valley for 30 miles, to the "Top Camp" Gold Diggings, and eastward to the copper and gold mines near Mount Douglas. I may mention here that I am under deep obligations for guidance and assistance to Mr. Reginald Uhr, Police Magistrate at Hughenden, Mr. Ernest Henry, the discoverer and part owner of most of the copper mines in the district, and lastly, to Mr. A. Macphail, whose experience, as prospector and miner, is extensive and practical.

In latitude 20 degrees 10 minutes south, a porphyry range divides the Dugald from the Leichhardt waters. Some copper lodes occur, I am informed, in the porphyry. Between the range and the Dugald is a belt of nearly vertical black slate and quartzose greywackes, with a bed of limestone. In this belt are some copper and lead lodes, which I visited in company with Mr. Uhr. The lead selections lie nearest the range, and occur in a wide lode which can be followed on the surface for nearly a mile, from north 20 degrees west, to south 20 degrees east; not only by the continuous outcrop of gossan, but also by the absence of vegetation. At the north end is a mass of gossan, stained with carbonate of copper, and mixed with plumbago. From this point for three-quarters of a mile to the south, a wide belt of lead gossan is seen, containing red oxide of iron and yellow lead ochre, along with decomposed plumbago shale. Two shafts have been sunk, one of them to a depth of 20 feet, with a trench at the surface, 17 feet long and 8 feet deep. Trench and shaft alike exhibit a gangue of what may be described as graphitic shale, foliated and contorted, and all more or less impregnated with yellow lead ochre and peroxide of iron; some red oxide of lead also occurs in places. One tongue of lead ochre extends from the top to the bottom of the shaft, with a slight underlie to the east. At a depth, the usual change from lead oxides to carbonates, and finally to galena, may be confidently expected to take place. Assays of the ore by Mr. Karl Staiger showed antimony, and traces of silver as well as lead. Lead lodes of such an extent are very rare, and most Australian lead ores contain a payable proportion of silver. I consider that the prospects of the Dugald mine are very good. At the south end of the lode its character alters. It shows there a red gossan, with stains of carbonate of copper.

A mile to the south-east of the lead lode is the No. 1 Copper Selection. It lies among upturned and altered stratified rocks. Near the river is a white crystalline limestone, 50 or 60 feet thick, with siliceous granules, and

contains large masses of native copper. The cap of the lode is composed of a siliceous matrix with green carbonate.

specks of black mica, dipping at 75 degrees to east 10 degrees south. Below the limestone is a series of grey siliceous and talcose slates or shales, impregnated and coated with green carbonate of copper. This series is of varying thickness—at least 100 feet—and is accompanied by a weathered granular siliceous and hornblendic rock, impregnated with carbonate of copper ("green gossan"), especially in the form of amygdaloidal kernels. These masses evidently are not part of the stratified series, but vein deposits or gangue, as they intersect the bedding in places, although their general tendency is to follow it. Two trenches have been cut across the outcrop of the cupriferous zone or lode (which runs north 10 degrees east). One trench is 22 yards long; it discloses a considerable quantity of the "green gossan," which cuts in and out of the bedding of the stratified rocks. The second trench is 20 feet long and 8 feet deep; it shows towards the bottom large blocks of ruby oxide coated with green carbonate, and frequently containing veins of native copper. The oxide is remarkably pure. Besides the "green gossan" large masses of ferruginous gossan occur on the cap of the lode. Large lumps of carbonate and oxide of copper can be picked up loose in the gullies near the lode.

Williams' Creek rises in granite country, which should be prospected for tin ore.

Mount Leviathan, on the left bank of the Cloncurry River opposite the township, is a mass, say 200 feet high and a quarter of a mile in diameter at its base, of the purest possible iron ore.* The greater part of it is massive or granular specular iron ore, with only a few grains of siliceous sand. Specimens of foliated specular iron may be picked up, and parts of the mountain are of magnetite. The specular iron is frequently magnetic. From the summit a number of quartz reefs and ironstone lodes may be seen radiating from the mountain. Such an inexhaustible mass of ironstone would be very valuable if the carriage to the manufacturing districts were not excessive. Two hundred and ten miles of railway would connect this ironstone with the Winton coal, when the rest of the railway might be constructed with locally manufactured steel. It is not impossible that, with a short line connecting the Cloncurry with Point Parker, manufactured iron might even be exported at remunerative rates.

Half-a-mile south of the township, is a smaller hill of specular ironstone, equally pure.

The "*Great Australian*" Copper Mine lies between the last-mentioned ironstone hill and the township. It may almost be described as a mountain of copper. It occurs as a ridge about 30 feet in height and over 100 yards in length, with a general trend from north to south. It is intersected by two cross lodes, and has several branches. A detailed description is in preparation. At present I can merely say that numerous trenches and shafts only lead to the conclusion that "there is no end to it." The most valuable ore is the red oxide, which is obtained in great purity, and often

* Mr. J. Brownlie Henderson, Government Analyst, to whom a specimen was recently submitted for analysis, reports that the sample is "practically pure iron oxide, containing only a little silica." R.L.J., 1898.

ERRATA.

On first sheet of photographs, for "Great Australia" read "Great Australian."

PAGE 10.—The first two lines should be the last two.

About a quarter of a mile to the south-west is another large deposit of copper known as the "Contra Lode." It occurs in diorite country. Its trend varies from west 15 degrees north to west, and the lode is traceable for about 400 yards. It is at least ten feet wide, and has a large ironstone cap with much green, and some blue, carbonate. Not much has been done beyond some stone-breaking on the surface, a little trenching, and the sinking of a shaft about 20 feet deep. The latter shows a thickness of about two feet of pale red oxide of copper, locally but incorrectly known as "grey ore," with some copper pyrites and much green carbonate. Its eastern end is crossed by a gully whose alluvium obscures the outcrop. When it is next seen it has become almost entirely an ironstone lode, and a little further it changes to a vein of white calc-spar impregnated with carbonate of copper.

The "country" in the immediate neighbourhood of the Cloncurry copper lodes and township is composed of vertical slates and sandstones, with some crystalline limestones, the whole intersected by intrusive masses of diorite.

Eastward towards the Mount Douglas mines (which I visited before your arrival, and afterwards in company with you), similar country prevails, with the addition of peculiar rugged knobs of granular quartzite. Unless these latter be the discharge-pipes of "geysers" which poured out hot water containing silica in solution, I am at a loss to account for them.

On the north bank of Pumpkin Gully, a copper lode (nearly vertical) runs from south-west to north-east. It has a large cap of red ironstone, and green fibrous carbonate of copper, with some very blue azurite. Part of the gangue (which is siliceous) is mixed with red oxide of copper and "grey ore" (sulphide of copper and antimony). The lode is traceable for a quarter of a mile across Pumpkin Gully; only one hole has been sunk, about four feet deep.

Half a-mile to SSE. is the *Flying Dutchman*. It runs east and west and underlies to the north. The country is sandstone, with fine grains of mica. The matrix of the lode or reef is sandy (siliceous). The mine was originally taken up as a gold reef, and Mr. Macphail informed me that the stone, when crushed at the Queensland Machine, averaged 1 ounce 3 dwts. of gold to the ton. All that remains to be seen at the shaft is a quantity of glassy quartz, with green fibrous (radiated) carbonate of copper, and some grey copper ore.

Three hundred yards east of the "Flying Dutchman" is the *Homeward Bound* Copper Lode. It runs north and south. The shafts have become unsafe, but a little of the ore is lying about—green and blue carbonates, and some red oxide and native copper. The copper ore is said to have contained gold. A good deal of ore from this mine is stacked at the Queensland Machine.

North-west of the Homeward Bound is the *Uncle Tom* Gold Reef. Guided by Mr. Macphail, I explored, in your company, the galleries of the mine, and visited the bottom of the shaft (80 feet deep). The reef runs north 10 degrees west, and has an underlie at about 70 degrees to the west. North of the shaft the country is gritty hard sandstone or greywacke, and south of the shaft, slate crosses the reef, with an east and west strike. The reef averages two feet six inches in width, but the stone frequently

penetrates the foot-wall. The stone is a white glassy quartz with pockets of hæmatite iron ore, and numerous veins of calc-spar, and some chalybite (carbonate of iron). About 800 tons of stone have been taken from the reef, which averaged 16 dwts. of gold to the ton. I have in my possession at Townsville some specimens of free gold in calc-spar from the mine. A peculiarity of the reef is that the stone is apt to run off in floors or shelves, which dip to the north where the reef traverses sandstone country, and to the south in the slate country. At the bottom level there was no sign of water, but "mundic" (meaning in this case copper pyrites) had begun to make its appearance, an indication that the water level was near. The reef was abandoned in 1877, when rations and everything else were at famine prices. As examples, Mr. Macphail informed me that flour was £7 10s. per 200 lb. bag; sugar, 1s per lb.; candles, 2s. 6d; powder, 2s.; fuse, 3s.; and steel, 3s.

The "Uncle Tom" Reef is on the divide between Pumpkin Gully and Fisher's Creek. All the gullies draining into Pumpkin Gully have a shallow wash, containing gold throughout, at the rate of 2½ dwts. to the load. The whole of the gravelly surface is auriferous in about the same degree. The great difficulty is water, which is obtainable for only a month or two in the year. With water, the whole hill would pay for sluicing. Mr. Macphail dug out four bags of dirt, which we packed (say 280 lbs.) to the well at Fisher's Creek, where he washed them in your presence and in mine. The result was above 7 grains of gold, and a few specks of metallic bismuth. The gold was scarcely at all rolled, and was evidently not far from its source.

It is obvious that the whole of the gold which is so evenly distributed over the drainage area of Pumpkin Gully cannot have come from the few reefs which are now visible. Its chief source is perhaps to be found in reefs whose outcrops have been completely denuded and covered with surface wash.

Mr. Macphail also washed "colours" of gold from Fisher's Creek, below the well, in our presence.

As you have arranged to visit the Duck Creek Copper Mines, and to return to Cloncurry *via* the Top Camp Gold Mines, and this will afford me another opportunity of seeing them, I shall defer reporting on them till after our return.

I have, &c.,

ROBERT L. JACK.

SECOND REPORT.

On the 15th and 17th October, General Feilding, Mr. Robinson, and I, visited the copper mines of Duck Creek, and the gold diggings of the "Top Camp" at the Cloncurry, under the guidance of Mr. Ernest Henry.

After crossing to the left bank of the Cloncurry, opposite Mount Leviathan, the road to the township of Boulia (on the Bourke River) keeps a general SSW. course, crossing Chinaman's Creek (three times), Slaty Creek, Duck Creek, and the Malbon River.

Copper lodes occur on the western side of the road in a belt of country extending from Slaty Creek (near Mount Sheaffe), southward to the Malbon

—a distance of about 13 miles. This country is for the most part slaty, but is bounded on the east by quartzite ranges which run north and south. The quartzites are probably beds of altered and upturned sandstone. They still bear traces of vertical stratification.

On the road side, two miles south of Mount Leviathan, thick beds of limestone were observed. They were vertical, and had a NE. and SW. strike. The limestone was of a magnesian variety, with a slight mechanical admixture of siliceous granules. This lime ought to form a good hydraulic cement.

About three miles further, we saw, in slate country, on the road-side, a number of quartz reefs and hæmatite lodes, striking to the NE.

In a gully between the last crossing of Chinaman's Creek and Duck Creek waters (say 13 miles from Cloncurry township), I picked up large blocks of psilomelane (hydrous peroxide of manganese).

The road crosses the watershed between Chinaman's Creek and Duck Creek by an easy gap, in slate country, between two ranges of quartzites, which run, roughly speaking, parallel to the road. Supposing the railway to cross the Cloncurry River near the township, the ore from the copper mines about to be described would naturally (and I believe easily) be brought down to the railway by road, tramway, or branch railroad.

The northmost of the copper lodes *(Selection No. IX.)** is situated on the west side of the road, about 20 miles from the township, and within the drainage area of Slaty Creek, a large tributary of the Cloncurry. It is about one mile to the north of Mount Sheaffe, whose position is given on the map. The slate of the country in which the lode occurs strikes WSW. to ENE. Near the lode is a mass of diorite. Its relation to the slate is not very clear, but it is, in all probability, intrusive, and may be suspected to have influenced the production of the copper ore. The principal lode strikes WNW. to ESE. For about twenty yards it stands seven or eight feet above the ground. It has a quartz matrix, with great pockets of green carbonate of copper, red oxide, and "tile ore." A branch lode strikes off it to the south-east. It contains some green carbonate, which I should estimate to contain 40 per cent. of metallic copper, and some red oxide mixed with silica, which I should reckon 30 per cent. ore. From what can be seen at the surface, I should say this mine is capable of turning out a large quantity of payable ore.

The Rainbow Lode (marked "2454" on the map) lies about three and a-half miles to the south of Selection No. IX., on the fall of Cone Creek, a tributary of Duck Creek. It occurs in flat country, and shows a "blow" (striking WSW. and underlying to SSE.) of green carbonate of copper and gossan. A shaft has been sunk to the depth of 25 feet. The ore now lying at grass came from the bottom of the shaft, and is of very good quality—red oxide and green carbonate of copper (the latter enclosing quartz crystals), and silver-grey copper ore (sulphide of copper and antimony). The lode is traced for over 100 yards. At its west end it is crossed by a quartz reef running NW. and SE., and showing some red oxide of copper and some grey sulphide of copper and antimony. I consider the Rainbow quite a payable mine.

A selection *No. 2452* adjoins the Rainbow to the NE., and is understood to be on a continuation of the latter; but we had no time to visit it.

* For details, see Map, No. 1, on the scale of half an inch to the mile.

Two miles to the SW., on the eastern or left bank of *Cone Creek*, we saw a large reef of quartz, with pockets filled or cavities coated with green carbonate of copper. The reef runs east and west through slate, which has the same strike. It is more than likely that payable deposits of copper ore exist below the surface in this reef.

A selection has been taken up on the right bank of *Cone Creek*, on what is supposed to be the prolongation of the reef or lode last referred to.

A quarter of a-mile further down the creek (left bank) is a similar reef, striking east and west in a country of chloritic slate, having the same strike. The reef is at least 25 feet wide. It shows green carbonate and red oxide of copper of good quality, and I have no doubt will prove a valuable property, the large cavities lined with green carbonate in all probability representing "bunches" of ore. The ore, as well as the slate, is chloritic.

The selection *No. 2459* is taken up on a little outcrop of green carbonate of copper in a quartz reef running east and west, apparently of not much account. It lies on the right bank of Cone Creek, near its junction with Duck Creek, and about a mile SSW. of the reef last described.

The Chinaman's Lode occurs on the left bank of Duck Creek, about a mile and a-half SE. of No. 2459. It runs from west 30 degrees south to east 30 degrees north. It is a quartz reef, standing from 3 feet to 15 feet above the general level, and measuring 17 feet across. It runs for nearly a quarter of a-mile through slate, whose strike is parallel to the lode. The quartz has its cavities coated with green carbonate of copper, and very often the quartz when broken up is found to be intimately mixed with carbonate of copper. Both slate and ore are highly chloritic.

In the selection numbered *2458* (2 miles WNW. of the Chinaman's) I saw two lodes. The first runs west 10 degrees south, is well defined, and about three feet wide, with a dip to south 10 degrees east at 75 degrees. Besides green carbonate of copper and some hæmatite iron ore, a good deal of very fair grey ore is visible. This is a sound payable lode. A second lode parallel to that last described is said to occur in the same selection, but we were too pressed for time to visit it.

A hundred yards to the south, still in the same selection, is a third lode with two quartz reefs running to the SW. A considerable quantity of green carbonate of copper is visible on the surface of the lode. The country is chlorite slate and greywacke, turned up on end and having a strike to WSW.

Selections Nos. *2457* and *2456* are taken up on continuations of the lodes in Selection No. 2458, and carry their outcrops on to the ENE. for about half a-mile. We had not time enough to inspect these properties.

Nine miles SSW. of the group of lodes last described, two copper selections (*Nos. III* and *V.*) have been taken up on the south or right bank of the Malbon. As the time at our disposal, however, was very limited, we did not inspect them. They lie about 33 miles from the Cloncurry township, by the Boulia track, which is a good practicable road. Probably, however, if the railway should touch at the Cloncurry township, a tramway or branch railway would supersede the road, and it might keep a pretty straight course, and yet need never be much more than a mile from any one of the whole chain of mines extending from Slaty Creek to the Malbon River.

From the copper selection, No. 2458, we ran down the right bank of Duck Creek for nine miles in a general south-easterly direction to the point where the Malbon River comes in from the west, and the Cloncurry River from the SW. Then keeping down the valley of the Cloncurry, for eleven miles further to the NE., we reached the "Top Camp," which is about 30 miles up the river (south) from the township.

At the *Top Camp* the country is of slate and greywacke, both chloritic, in nearly vertical beds, which strike SE. and NW. The slate makes very bold and striking features on the tops of the hills, often standing up in fantastic knobs. The slate and other stratified rocks are often pierced by enormous dykes or reefs or quartzite, which stand up in lofty walls on the crests of the mountains.

At the head of Armstrong's Gully, in slate country, is a hill named the *Mary Douglas*, in which a quartz reef was taken up, and worked for some time (up to 1878). A good deal of gold was obtained in association with native bismuth. Owing to the tumbled-in state of the workings I could see little of them, but I was satisfied that the reef or leader which was worked did not extend far horizontally. Whether it did so vertically, I had no means of judging. Numerous small quartz veins were seen in the hill, but none of any extent. The crown of the hill is so bare that no large quartz reef could escape observation.

The quartz of the reef which was worked is very peculiar, being coated with botryoidal and stalagmitic masses of glossy-black limonite. Sometimes the quartz is marked with impressions of large cubical crystals (probably of pyrites) which have weathered out.

The surface wash on the slopes and base of the Mary Douglas Hill yields colours of gold—and from the hill there radiate in every direction gullies and alluvial flats which have yielded gold extensively, at one time employing 400 men. Prominent among these are the Chinaman's Flat (in which a 28lb. nugget of gold was found), Red Jack Flat, and Sharkey's Flat. Chinaman's Flat runs to SSW., and has been worked out for nearly half-a-mile. It takes its rise in some gullies known as the Jeweller's Shop, Dycot's Gully, Ironstone Gully, and the Secret Lead. Sharkey's and Red Jack Flats run ENE., and have been worked out for about half a mile each. Linger and Die Gully runs to the west of and parallel with Chinaman's Flat, and has been worked for a quarter of a mile. The workings generally have bottomed on the slate rock at depths varying from 20 to 40 feet. I have been informed that all the gold obtained from the alluvial diggings at the Top Camp was heavy and nuggetty. It must have been derived from the denudation of a number of quartz veins in or about the Mary Douglas Hill.

That such an extent of alluvial country should have been profitably worked under the present conditions—not a drop of water being visible in the flats for more than half the year—is very surprising. If water were brought from the upper reaches of the Cloncurry, the whole of the flats might be washed down in a face by hydraulic power.

On my previous visit to the Top Camp I returned through the mountains on the right bank of the river, and saw much similar country, with alluvial flats apparently promising equally well, but this ground is still untouched by the miner, and I could not prospect it for want of water —and time.

From 21st to 30th October inclusive, General Feilding and I were out to the west of Cloncurry valley, inspecting another metalliferous region, under Mr. Henry's guidance. Mr. Henry was so unfortunate as to break a rib and have both his eyes almost closed up by swelling blight during this excursion; but although suffering great pain, that indefatigable explorer insisted on carrying out his whole programme.

Camping in the afternoon of the second day on the Dugald River, we visited the *Number 1* copper mine and the lead mine described in my previous report. On the third day we continued our journey up the left bank of the Dugald in a general SSW. direction.

Three miles from the camp we passed a large "blow" of quartz running north and south, with a ferruginous gossan on its east side, containing a few specks of lead ochre. This reef is probably the continuation of the lead lode.

A quarter of a mile to the SE. we saw another good copper lode (iron-cap and green carbonate). It ran east and west, with an offshoot running to the SE.

About five miles further (to the south), we passed a singularly barren piece of bare rocky country. Fine-grained greywacke beds, about six feet in average thickness, stood on end. The beds had a north and south strike and a marked east and west cleavage. The greywacke varied in composition and color, being sometimes blue and calcareous, and sometimes nearly black and full of iron pyrites.

From our camp near No. 1 copper mine our general course up the Dugald was SSW. for the first 30 miles, when the valley narrowed to a ravine, which we ascended for three miles to WNW. Up the river the slates and greywackes gradually became more altered, sometimes to mica schists and gneisses, but they always had a recognisable N. to NW. strike. Huge quartzite dykes or reefs cross the valley. Where one of these crossed the river near Mount Eurie we found a waterhole and camped. There was no water in the river between this and where we last camped, 33 miles down.

Accompanied by Mr. Henry, I ascended Mount Eurie and some higher eminences in the neighbourhood. Here Mr. Henry broke his rib by falling on a pointed stone. Mount Eurie is capped by a thick vertical bed of limestone, a good deal altered, but full of a fossil like *Lithostrotion.** The limestone is accompanied by slates with a north and south strike.

I obtained from Mount Eurie an extensive view to the south over a tumbled wilderness of slaty mountains, intersected by great dykes of quartzite and reefs of white quartz. The features of the country strongly remind me of the Hodgkinson Goldfield. Very few, I think, even among northern miners, have any idea of the extent of this tract of possibly auriferous country.

In a valley to the west of Mount Eurie, Mr. Henry and I found some fine almandine garnets, Labrador felspar of the beautiful iridescent variety used in jewellery, some micaceous iron ore, and some lumps of rotten ironstone with slight copper stains, such as generally yields gold in the Cloncurry district.

In 12 miles to the SW. we reached and camped on a waterhole in Argylla Creek, a tributary of the Leichhardt. Our camp was shared by a

*On subsequent examination this proved to be not a fossil, but the mineral scapolite in a weathered condition. R.L.J.

small party of aboriginals, of the circumcised tribe of Calcadoons. They treated us with civility after their fashion, and stole nothing. Mr. Henry's dray, which had been left near the place for two months, was found to be untouched.

From Mount Eurie to the Argylla camp the country was somewhat broken and ridgy. The rocks were slates and greywackes (striking north and south), sometimes chloritic and sometimes siliceous, occasionally altered to schists and gneisses, and traversed by huge "blows" of quartzite and smaller reefs of quartz, often iron-stained and cavernous—rather likely country for gold, I thought. Three miles from the Mount Eurie camp, we passed a little rock-bound waterhole near the head of the Dugald, and shortly afterwards crossed some ridges to the Leichhardt waters, passing on the way two or three smaller outcrops of copper ore.

Near the head of Argylla Creek is the *Argylla Copper Mine.*

The Argylla Mine is a wide belt of copper-bearing country running NNW. to SSE. The dominant feature of the belt is a wide reef of rather open and friable quartz, standing up as a crest on a hill top for about three-eighths of a mile, and nearly 80 feet above the general level of the slate country.

The western side of the quartz reef at its north end is stained with carbonate of copper, its numerous caverns being conspicuous from a long distance owing to their bright green colouring. Traced to the south the whole is seen to be a belt of copper lodes, generally running parallel to the dominant quartz reef, but sometimes running out obliquely from it, and abutting against parallel veins of quartz. We saw a good deal of green carbonate of copper, often radiated and fibrous, and of the highest possible percentage. We could also knock out or pick up on the hill side, or in the gullies, heavy boulders of red oxide of copper and grey ore.

The Argylla property will take a large sum of money to explore. No company without very considerable capital should, in my opinion, attempt the task, but I believe the expenditure would be richly repaid. The green-painted caves in the quartz, I have no doubt at all, represent great bunches of ore which have been denuded.

The Argylla ore would come down to the railway by the valley of the Dugald. Supposing the railway to cross the Dugald near the copper and lead mines, the distance from Argylla to that point would be about 45 miles. Or the ore might possibly come down the Cabbage Tree Creek valley to the west; but that would naturally depend on the course taken by the trunk line. Mr. Henry has taken a loaded dray from the Leichhardt to Argylla *via* Cabbage Tree Creek. The track down the Dugald is quite practicable, either for road or tramway.

On the divide between the Dugald and Argylla Creek waters, Mr. Henry pointed out a hill (about a mile north of his dray track) where he had found manganese ore.

After returning to the Mount Euri camp, on the Dugald, we kept Mr. Henry's dray track, which, after emerging (in three miles to the ESE.) from the narrow valley, runs northward towards Cabbage Tree Creek. In eight miles to the north we camped on the Portal Creek branch of the Dugald. Our course for the greater part of the northward journey lay through granite country. As in its general features this country resembled the stanniferous district at the head of the Walsh River, I prospected for tin after we had camped; but found only "nuggety" specular and magnetic iron in the wash.

At this camp we left the dray track and followed the river down, passing out of the mountains about two miles ENE. of the camp by a gorge (slate and greywacke striking north and south, with much specular iron strewn over the ground); then after travelling NE. through open timbered country and well-grassed plains, fringed with gidya, we struck in about six miles our former track up the Dugald at the "singularly barren piece of bare rocky country," about 11 miles from our camp, near the copper and lead mines.

After emerging from the gorge, we saw on the left some mountains capped with a horizontally-bedded rock, probably Desert Sandstone.

On the 28th October we travelled down the right bank of the Dugald for about five miles, part of the way through granite country, and camped beside a mob of Mr. Henry's horses which were spelling under charge of a blackboy. At this camp we saw some cabbage-tree-palms, the first tropical vegetation we had seen. The blackboy was sent back in the afternoon to the camp we had left in the morning, and brought a message from the party who were following with the waggon and horses.

The following day we crossed (WNW.) from the Dugald to the Leichhardt, a distance of about 10 miles. On the divide were some ridges of slate and sandstone (vertical, with a strike to NNE.), intersected by large quartz reefs and "blows" of hæmatite. About a mile from Cabbage Tree Creek we passed on the left a tower-like mass of hæmatite standing up 20 feet high.

Crossing Cabbage Tree Creek (an unimportant dry water course) we held northward by its left bank for eight miles, and camped at Walsh's station on the Leichhardt River, about two miles above its junction with Cabbage Tree Creek. The country down Cabbage Tree Creek was level, and fairly grassed with a few gidya and other trees. The soil was a light sandy loam.

The other members of the party arrived at the same camp at dusk. On the following day we again left them, to visit under Mr. Henry's guidance some mines to the west of the river.

We followed Mr. Henry's dray track for about six miles to the NW. when the road began to rise into broken country—black hornblendic slate, and sandstone altered to greywacke—vertically bedded and striking north and south, with enormous "blows" and reefs of quartz.

In three miles more the road turned more to the west and ascended a valley, on the south side of which was a mountain capped with a gigantic quartz reef (east and west) weathering into fantastic shapes. On the north side of the valley was a similar, though smaller, reef. Narrower reefs ran across the valley in every direction between the two dominant reefs, often standing up like ruined masonry. By a gap, we passed westward into the valley of an affluent of Sunday Creek, the same features continuing. In one place I counted five quartz reefs crossing at a single point, and near this I observed an outcrop of copper ore.

A mile further, the *Crusader Copper Lode* (12 miles from Walsh's camp) stands up boldly above the surrounding country. Its matrix is quartz, which can be seen from a distance to be stained green with copper ore. The lode runs north 40 degrees west and is about 50 feet wide. On the surface and sides are large masses of copper ore and gossan. I broke out some fair samples of red oxide, malachite, and grey ore. The ore is more intimately mixed with silica than is usual in this district. A cutting

has been driven into the NE. side of the lode for a distance of about 15 feet. Besides copper ore, the cutting shows a large quantity of specular iron in a matrix of pale green talc. The association, in the same lode, of copper ore and ironstone, is suggestive, considering the number of enormous outcrops of ironstone which occur in the district.

Four miles to WNW. (after crossing Sunday Creek and Dobbin's Creek, which unite to form a pretty large tributary of the Leichhardt) we came on *Dobbin's Lode*. It runs north and south, and is the continuation, on low ground, of a large quartz reef or ridge which stands up at its south end. The lode is about 15 feet wide. It shows a promising gossan of green carbonate of copper mixed up with quartz. Our visit was made within an hour of sunset, and we had to hurry on, as the nearest water was six miles off. I much regretted having no more time to bestow on these interesting mines, as I could not help thinking that many of the quartz reefs in the district were just as likely as the Crusader and the Dobbin to become locally metalliferous lodes.

Fourteen miles NNE. of Dobbin's Lode we recrossed the Leichhardt. At the crossing, Mr. Henry left us. We ran the Leichhardt down on the right bank to Kamilaroy, a distance of 18 miles. Here we were rejoined by the other members of the party, on the afternoon of 1st November.

Mr. Curr, the managing owner of Kamilaroy, informed us that he had obtained "colours" of gold in a small affluent of Dobbin's Creek in granite country, and that copper lodes occur in the valley of St. Paul's Creek, a tributary of the Leichhardt, west of Dobbin's Creek.

At Kamilaroy and the "Grass Gunyah," 12 miles to the south, we observed extensive outcrops of magnesian limestone. At Kamilaroy, the limestone yielded specimens of shark's teeth, echinus spines and plates, belemnites, mollusca, &c.,—enough to prove that it formed part of the "downs" formation, the same which extends from Cloncurry to Hughenden.

Thirty miles below Kamilaroy we passed Lorraine Station (Brodie's). We crossed the Leichhardt for the last time, six miles below Lorraine.

The Leichhardt is a very large river, which rises nearly 100 miles south of where it is shown on the map.* Its head overlaps that of Wills' Creek. The river has chains of large waterholes, which are sometimes connected by a trickle of water. There has been no rain now for eight months.

Down the right bank of the Leichhardt, so far as we traced it, the soil is a light sandy loam, and grows rich grass. The country is sometimes open and sometimes lightly timbered. From the Cloncurry, as far as our lowest crossing-place of the Leichhardt, there is a practicable route for a railway, over country which is not subject to floods.

Nine miles NW. of the Leichhardt, we crossed Sandy Creek. Between the two watercourses we crossed some low-lying "devil devil" country and blue-bush swamps. As we approached Sandy Creek we saw a good deal of flooded land, with long "oaten grass," while the trees in the bed and on the banks of the creek itself bore the marks of most appalling floods.

Plevna Station (Mr. Percy's) is situated on Sandy Creek, above the place where we crossed.

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* It is now better charted. R.L.J., 1898

We struck the road from Normanton to Port Darwin, about five miles north from Sandy Creek, and kept it as far as Gregory Downs, on a general course of WNW. Sixteen miles after striking the road we passed Messrs. Scott and Gibson's station of Fiery Downs, on Fiery Creek. The first half of the journey was over country, not exactly liable to inundation, but probably covered in the wet season by a sheet of water, which is finally got rid of by evaporation rather than by drainage. Near Fiery Creek the country is flat, with grassy plains and gidya, but is apparently beyond the reach of all but very exceptional floods.

Between Fiery and Gregory Downs Station (Watson Brothers') the greater part of the region traversed by the road is open downs, though the downs can hardly be described as "rolling." The soil is dark, and ought to be fertile, but it appears to be sour from the stagnation of the water which falls on it in the form of rain.

ROBERT L. JACK.

THIRD REPORT.

On 9th November last, General Feilding left Gregory Downs to proceed to Point Parker, and, acting under his instructions, I returned to the Leichhardt by a route to the south of that by which we had travelled to the Gregory.

My plan was to run up the Gregory valley some distance and strike for the junction of the Leichhardt with Cabbage Tree Creek, so as to be enabled to judge (firstly) whether there was any promise of a mineral traffic arising from the district; and (secondly) whether the construction of a railway there would be practicable.

The first day's journey was uninteresting and monotonous, being (by the Rocklands road) either on the level downs, or on the alluvial flats or sand-ridges of the river. The sandy ridges were pretty well timbered with gum, bloodwood, and Moreton Bay ash, the latter rather larger than is usual in this district. We camped on the Gregory, 14 miles from the station, beside a yard and a tree marked broad arrow over ADI over W over VI in tablet. (Camp 1.)

On the 10th we continued our journey up the valley of the Gregory. Four miles from the camp a little hill on the eastern side of the road showed some beds of fine-grained hard blue limestone, and fine-grained hard siliceous flagstones, dipping to the west at 70 degrees. A few miles to the east a low range was observed, in which the successive outcrops of upturned stratified rocks, having a north and south strike, were very noticeable. Half a-mile further a second little hill was seen on the western side of the road, with limestones and flagstones, dipping at 75 degrees to the east. Between this hill and the river, the strata rolled over again and dipped to the west.

At the south end of the hill a little work has been done on a small quartz reef, which coincides with the bedding of the rocks (north and south). A little "tile ore" and green carbonate of copper is mixed up with the quartz, but I should not expect the deposit to be present in payable quantities.

Between this hill and the range to the west the whole valley is not more than half a-mile wide, and the river is confined to a single channel, about 50 yards wide and very deep.

About 27 miles above Gregory Downs the range comes close to the right bank of the river, and is composed of fine-grained buff-coloured sandstones (on which I noticed annelid tracks), dipping at 30 degrees to ESE. To the south I saw a long stretch of hills of similar structure. Looking up the valley I could distinctly see the dip reversed on the left bank of the river. Between the range and the river is a long lagoon, which overflows into Police Creek, near its junction with the river. There had been heavy rains here shortly before (probably on the 7th), as the ground was still boggy and Police Creek had been running strongly.

Above the mouth of Police Creek, the hills approach close to the river on both sides, and the "strangulation" of the river evidently gives rise to great floods. Judging from the marks on the trees, the road must be fully 25 feet under water in times of heavy rain. At this point the sandstones and shales have undergone a greater degree of metamorphism than is usual here, the former being altered to quartzites, and the latter to slate, Lydian stone, and flint.

On emerging from this defile, the road turns SSW. and keeps well out from the river, crossing open grassy plains for about 10 miles, till it enters the valley of an insignificant watercourse, which it runs up, in a south-westerly direction, for about six miles.

Near the mouth of this valley, and 100 yards north of the road, I saw a gossan outcrop running north and south in slate country. This gossan, although it contained no visible ore, except of iron, was sufficiently promising to suggest a more minute examination of the locality if I could have spared the time, but night was coming on, and the road had taken us far from the river, so that our first anxiety was to obtain water for the horses.

At the head of the valley the road dropped into the valley of the O'Shannessy, and took a north-westerly direction across an open plain. Here we saw some natives, who ran away.

As it shortly became so dark that we could no longer see the road, and our horses were tired out, we were under the necessity of camping in the open plain without water. We had not filled the water bags, as I was under the impression that the road kept close to the bank of the Gregory. About 11 o'clock, however, a thunderstorm burst on us, and rain fell in torrents for about three hours. Three inches of rain at least must have fallen, as the "billies" caught that amount of water, and the prospecting dishes were running over. (Camp 2.)

November 11th.—In the morning we found on continuing our journey (to the NW.) that we had been camped not more than a mile and a-half from the O'Shannessy River—a fine running stream of about half the volume of the Gregory.

On crossing the O'Shannessy the road turns to the north, and in three miles reaches the police barracks on Carl Creek. (Camp 3.)

The police station is situated on the right bank of Carl Creek, a fine rushing stream, which leaves the Gregory and runs into the O'Shannessy. As the two rivers join a few miles below the barracks, a large island is formed by the three streams. Mr. Shadforth's station is situated on the island nearly opposite the police barracks.

Behind the barracks is a large open plain, which is bounded on the south by cliffs of a hard, yellowish limestone, horizontally bedded. This limestone evidently occupies an old depression, and overlies (unconformably) the nearly vertical sandstones, &c., which form the staple of the formation prevalent in the district, and which rise on the right bank of the O'Shannessy to a greater elevation than the limestone. The summit of the limestone is a plateau, which, as I am informed, extends to Rocklands, under the name of Barkly's Tableland.

About 20 miles above Carl Creek, the Gregory, as a running river, may be said to rise, as the water gushes out there from beneath the limestone and begins to flow, although the dry river bed can be traced back into the Northern Territory of South Australia.

November 12*th*.—I deemed it unnecessary to go into the limestone tableland in search of mineral country, more especially as, even if minerals should be found there, they would probably go by dray to Point Parker, if a port were established there. I therefore returned down the Gregory with the intention of striking south-eastward, from near the mouth of Police Creek. I took "Armit's short-cut," which crosses the O'Shannessy two miles from the barracks, and keeps nearly paralled to the Gregory.

After leaving the O'Shannessy, the track cleared two passes in the mountains, and got down into comparatively low country, and finally into open grassy plains. The rocks in the mountains were mainly sandstones, always hardened but rarely altered otherwise. Ripple-marks were frequently observed on the sandstone. The "short-cut" is about 14 miles in length, and joins the dray track nearly opposite Horse Creek; near the junction of the roads the bridle path passes close by a hill, near which I observed some fragments of manganese ore. These I traced to a little knoll where there was a "blow" of the ore, but it was not clear in what direction the lode ran. There were large blocks of very pure psilomelane and some of wad.

We camped on the dray road about two miles from the outcrop of manganese ore at the place where the "strangulation" of the river has already been mentioned. (Camp 4.)

After we had camped, I made a tour round the hills south of the camp (on the left bank of Police Creek), and found (about 300 yards from the river) another outcrop of very pure manganese ore (psilomelane).

From this point, our route, as laid down on the map accompanying this report, will explain at a glance the nature of the country traversed, and the difficulties which prevented our steering a straight course as originally intended.

I have no doubt that an engineer could take a railway from the mouth of Police Creek, to the junction of Cabbage Tree Creek, but the notes which follow will give some idea of the difficulties to be overcome. The line would certainly be a very costly one, and its construction could only be warranted by valuable inducements in the form of land or mineral traffic.

November 13*th*.—For four miles to the SE. our way lay through nearly level lightly-timbered country, with low isolated hills on both sides. Undulating strata of sandstone, and a few of limestone, composed the hills. Two miles from the Gregory we passed a hill on the right, on which I picked up pebbles of manganese ore (pyrolusite) and hæmatite.

At the end of the four miles from the Gregory we crossed Police Creek. It was dry, and had a wide, shallow, gravelly bed. Its flood channels covered about a furlong of ground.

On the right bank of the creek we found a very wide and high lode of quartz and peroxide of iron, running east and west.

For three miles more we kept a south-easterly course, with rather high hills on our left (sandstone and slate, with a WNW. strike). The greater part of this distance was over low stony ridges covered with spinifex grass. Slate beds seemed more numerous here than usual in this region, and the same may be said of quartz reefs.

After crossing the stony ridges above referred to, we ran down a gully from its head to the east for half a-mile. On the right bank of the gully I noted three large lodes of hæmatite and yellow ochre in a matrix of quartz. Near this point we crossed the gully, which took a southerly course, and resumed our journey to the SE. In about a mile we crossed some stony ridges, and after crossing a flat (to the east) for half a-mile, we camped beside a little waterhole filled up by the rain of the 10th. (Camp 5.)

November 14th.—For two miles south-east of the camp we traversed stony flats, grassy, and timbered with small gum, bloodwood and box, crossing a creek of the fourth magnitude* which ran to the west. We then got on low hills covered with spinifex, and with higher hills to right and left. Half a-mile through the ridges to the SW. we saw a quartz reef running east and west. The increasing size of the hills on our left hand made it more and more impossible to keep our intended south-easterly course, and we were glad to get south for two miles, when we found a creek of the fourth magnitude falling to the west.

For the next two miles we kept our intended south-easterly course, till we crossed a gully falling into the creek last-mentioned.

In half a-mile (SSE.) we came to the right bank of a fourth magnitude creek coming out of the high range on the left. In the hope of finding a passage through the range by the valley of this creek, I led up it for half a-mile to the east, but the valley narrowed to a gorge, and I halted the horses and ascended the range (about 800 feet), to have a look ahead.

The view was disappointing. I could see nothing but a broken table-land, very stony and rough, and utterly barren, but for the spinifex, which was much worse than no vegetation at all. The ranges appeared to get higher to the south. Its structure was simple—hardened sandstones, sometimes ripple-marked, and here and there altered to quartzites, with a general dip of 25 degrees to the west. The outcrops of the various beds of sandstone, presenting their escarpments up the creek, formed a series of dams, and I could see from the hills a chain of waterholes nearly a mile in length, probably all due to the late rain.

Returning to the point where we had first struck the creek, we turned northward, and after travelling for a mile and a-half in a narrow bottom between the high range and some low hills on the left, reached a creek of the fourth magnitude, which emerged from the high range, and breaking through the lower hills ran NW. We followed the creek down for about a mile till we found some grass and an inky waterhole due to the late rain. Here we camped. (Camp 6.)

After we camped, I again ascended the range. Its character was unchanged, and I could see that the broken table-land was at least five miles wide.

* In my Report on Explorations in the Cape York Peninsula (Brisbane: By Authority, 1881) I commenced a system of naming Creeks "first," "second," "third," or "fourth" magnitude, so that some idea might be given of how far the point described was distant from the head of the watercourse. The suggestion has not been generally adopted. R.L.J., 1898.

November 15*th*.—As some of the horses were now very weak, and two had lost shoes, it would have been impossible to take them across the range, although fresh, well-shod horses might have done it. The only course now open to us was to go northward till some opening to the east presented itself.

Returning up the creek on which we had camped, to the place where we had first struck it yesterday, we turned to the north in this direction. After threading our way among stones and spinifex for about four miles between the range and the lower hills on the left, we had the satisfaction of seeing that the country became rather more open, and that the range began to dwindle. In half a-mile to the north-east we crossed the range by a gap in a sandstone cliff, and got on the fall of Fiery Creek. It may be mentioned that where we returned to cross the range, we saw a well-built wet-season native hut, capable of holding half-a-dozen. A man could stand upright in the centre. It had a framework of saplings brought together at the tops so as to form a sort of dome, which was closely thatched with spinifex grass.

As soon as we had crossed the range we found ourselves at the head of a narrow grassy valley, falling between low hills, to the east. We kept the valley for about two miles, when the creek turned to the NE, and we left it, and steered again to the SE.

In one mile to the SE. we crossed a fourth magnitude creek running north.

The next two miles (to the east) were over stony ridges, on one of which I observed an outcrop of pyrolusite. We then ran down a gully, from its head, for three miles more to the east, till it fell into a large creek or river, with high mountains on its right bank. We ran the river down for about a quarter-mile to the NNE., and camped beside a large waterhole near a tree lately marked (by Mr. Bedford, Licensed Surveyor) broad-arrow over F over 74 in tablet. (Camp 7.) This "river" is Fiery Creek, and it seems here of much greater importance than it did where we crossed it before, some 40 or 50 miles lower. I should not expect to reach the head of Fiery Creek in less than 50 miles above the 74-mile tree. I do not think we saw two square miles of available country the whole day. The greater part was grassed with spinifex only.

November 16*th*.—As the range on the right bank of Fiery Creek was evidently too high to be crossed here, I resolved to go down the valley for some miles before striking eastward. We crossed to the left bank of the creek about half a mile below the camp. I have since learned that there is a cattle station (Mellish Park) on the creek, about a mile below our camp. Two miles to the NNE. (with a hill on our right), we crossed the creek.

Striking out from the creek to the NE., we crossed at two miles a fourth, and at three and a-half miles, a third magnitude creek. Up to the latter we had tolerable travelling, as we could generally avail ourselves of grassy hollows, though the ridges were stony and covered with spinifex.

The next two miles to the NE. were hard on the horses, as the ground was very stony. The range on our right had seemed impassable hitherto, but I now resolved to try a passage. The attempt, however, had to be given up, as my reconnoitring on foot disclosed the fact that what had seemed a breach in the hills was only the avenue to further ranges, intolerably stony and a mass of spinifex—passable only for fresh horses, all

shod. Three of the horses had lost fore shoes. One was knocking up, and another had got strange swellings on the back and head—caused, as I afterwards discovered, by his having got a gidya splinter in his back while rolling. I therefore resolved to return to Fiery Creek, and stop for a day to recruit the horses.

Two miles to the NW. brought us out of the hills. Here we saw four wet-season gunyahs; and in two miles more, in the same direction, across stony flats with spinifex and turpentine brushwood, we reached the creek and camped. (Camp 8.)

The hills seen to-day were of the same character throughout—sandstones and shales dipping to the NW. at angles varying from 10 degrees to 45 degrees—the sandstones sometimes hardened to quartzite. No quartz reefs.

November 17*th.*—While the horses were recruiting, we prospected in the creek, but could not get even "colours" of gold.

November 18*th.*—As the condition of the horses still forbade us to cross any more ranges for the present, we ran the creek down for about nine miles to NNE. (crossing it several times) till after emerging from a gorge into comparatively open country, we were at last enabled to get round the end of the range.

As the creek has many fine lagoon-like waterholes, and the alluvial flats, though narrow, are well grassed, the banks of Fiery Creek are a favourite resort for cattle in the dry season. The river gums on the alluvial flats of Fiery Creek are unusually large, and might supply sleepers for a railway. The part of the range seen to-day bears the same character as the part seen yesterday.

For six miles, in a general north-easterly direction, we skirted the base of the hills—the country rather poor and stony, with spinifex grass. The flats to the north, however, were evidently good grazing land. At the end of the six miles, we crossed the divide between Fiery and Sandy Creeks, and four miles to the east, across sandy-soiled country, fairly well grassed, and timbered with *Melaleuca*, *Bauhinia*, stunted bloodwood and occasional patches of brushwood, brought us to the left bank of Sandy Creek. We found this "creek" a river, though hardly so large as Fiery Creek. Like Fiery Creek, it was of more importance up here than it was where we formerly crossed it lower down.

From Sandy Creek we held straight to the east. At two miles we had the hills close on our right, but from this point they gradually receded from our course. At six miles we reached a creek of the fourth magnitude, which we ran up (to the SSW.) for half a mile, but as we found no water we continued our journey.

In a mile and a-half ESE., most of the way over crab-holed plains covered with rounded stones, and with little grass, we had to camp at sunset without water, on the edge of a gidyah scrub. (Camp 9).

November 19*th.*—My intention now was to make for Lorraine Station, where I could leave two spent horses to recruit, till Mr. Raff's arrival, and procure shoes for the others.

Two miles and a-half to the east we had to go south for half a-mile, to round a scrub. In three and a-half miles further (course east 10 degrees south) we crossed a low gravelly hill. In eleven miles further to ESE. we camped on a little water (due to the late rain), on Myally Creek. (Camp

10.) The creek was about twenty yards wide, with a sandy bed. We must have crossed Mittigoody Creek without noticing it, so that it cannot be a watercourse of much importance.

November 20*th*—In about five miles to ESE., we crossed the Leichhardt River, and found ourselves about a mile and a-half below Lorraine Station, where we camped. (Camp 11.)

November 21*st*.—At Lorraine, I was so fortunate as to meet Mr. C. Bedford, Licensed Surveyor, whose knowledge of this part of the Gulf Country is extensive and reliable. I spent the day in reducing from his maps, while the men were shoeing the horses. The map which accompanies this report is based on Mr. Bedford's surveys, with my own traverses and observations sketched in.

November 22*nd*.—Travelled by the road about fifteen miles up the Leichhardt, and camped at a deep waterhole between the 60 and 61-mile trees. (Camp 12.) The channel of the river is at its narrowest here, and I have seen no other place so favourable for a railway crossing the river.*

November 23*rd*.—About three miles further up the river we crossed it, just at the mouth of Gunpowder Creek, and for the rest of the day ran the latter up.

For the first ten miles, Gunpowder Creek is the very counterpart of the Leichhardt River, both in size and character. Higher up, the bed of the creek becomes shallow and diffuse, with a gravelly bottom and lagoon-like waterholes, surrounded by evergreen sweet grass. The land on both sides of the creek is level and well grassed for the first 14 miles, and bears a strong resemblance to the country near Lorraine.

About nine miles from the mouth of the creek, a limestone was observed on the left bank, very like that of Kamilaroy. It was full of small fish-teeth, fragments of chelonian plates and belemnites, with a few shells. I saw one minute ammonite.

At the Twelve-mile tree (the marked trees count from the mouth of the creek upwards—Mr. Bedford's furthest is 24 miles up) the banks resounded with the note of millions of black cockatoos. We camped by a waterhole near the 14-mile tree. (Camp 13.) The flood-bed of the creek (or river) here is about three-eighths of a mile wide.

November 24*th*.—At sunrise we continued our journey up Gunpowder Creek. At eighteen miles from the mouth of the creek we passed an innumerable army of flying foxes camped, head downward, among the tea-tree scrub by the edge of the river.

At 20 miles the country began to be rocky; and leaving the men to find easier travelling for the packhorses by the bank of the river, I kept well out among the low hills. These were composed of nearly vertical beds (striking SW.) of hard siliceous grit and ferruginous slate, with many small quartz reefs.

About 26 miles from the mouth of the creek we camped on a lagoon in the bed of the river. We found a tree marked TC over 78 on the right bank. (Camp 14.)

After we had arranged the camp, we visited the hills about a mile distant from the right bank of the river. The hills are capped by a very large quartz reef (north and south), which stands up like a wall to a height of 50 feet. The reef sends out numerous branches in all directions.

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* See Map No. 2.

In the large reef I saw a single speck of carbonate of copper. We packed down to the river some dirt from a gully which must receive a large proportion of the wash from the reefs; but were disappointed to find no "colours" in it.

Gunpowder Creek is very little known. In fact, I doubt if anybody has followed it much further up than our Camp 14; but I believe it must have a course nearly as long as the Leichhardt itself. I think I mentioned in a previous report that the Leichhardt goes much further south than is shown in the published maps; even overlapping Wills' Creek.

November 25th.—On leaving Gunpowder Creek we struck SE. for a gap in the hills where we had prospected yesterday. In about a mile and a-half we cleared the gap (having crossed on the way a third magnitude creek falling to the north-east). Beyond the gap we found slaty ridges, the slate having a north and south strike with quartz reefs.

Five and a-half miles ESE. from the gap, we crossed a third magnitude creek—in all probability Spring Creek—which falls into Gunpowder Creek, eleven miles from the mouth of the latter. I should have been glad to camp here and prospect; but after a search we could find no water, and had to move on.

Between Gunpowder and Spring Creeks the country was open and fairly well grassed. The remainder of the day's journey lay through a waste of spinifex and angular boulders.

On the right bank of Spring Creek were some low hills of reddish weathered slate. Here I found a vein of specular iron ore, and a quartz reef, seven inches wide, running north and south, through a greenish, chlorite-stained country of slate and quartzose greywacke.

A mile and a-half east of Spring Creek, I saw, in hardened white sandstone or quartzite country, occasionally chloritic, some gigantic north and south quartz reefs. Near the reefs were some diorite blocks, probably derived from a dyke.

One mile more to the east we struck a fourth magnitude creek, running to the north to join Spring Creek. On its right bank was a cluster of about a dozen native huts or gunyahs. We crossed the creek twice, and bore away to the SE. for four miles between two ranges of fine-grained white hardened sandstone or quartzite. The range on our left was the higher, and until we should find some gap in it there was little hope of getting away to the east.

A mile to the south I thought I had found such a gap, but instead of dropping down on the eastern fall, we found ourselves only at the head of a gully which fell to the west, probably to join Spring Creek. We followed it down for half a-mile and then got away for half a-mile to the south.

The range still presented an unbroken wall on our left (and whenever I ascended it on foot I could see no chance of getting the horses across, as similar stony ranges extended eastward as far as the eye could reach), and now forced us for a mile and a-half to SSW. across slaty ridges (with a high hill on our right), to a creek of the fourth magnitude, running WNW.

We had travelled through similar country for two miles to the SSE., one and a-half mile to the south, and one and a-half to the SSE., still hoping to get away to the east, and always meeting with disappointment, when we had to give up the attempt for the day. Retracing our steps for half a-mile, we ran down a gully to the SW. for a mile till it fell into the left bank of a fourth magnitude creek, where, to our unspeakable joy, we

found water, as well as grass, for the horses. I had quite expected a waterless camp, and had made up my mind to make a forced march next day back to Gunpowder Creek, as it might have been disastrous to have chanced the crossing of the range with thirsty horses as weak as ours now were.

November 26th.—As yesterday had been a very trying day for the horses, and several required shoeing, I thought it prudent to spell them here for a day while I reconnoitred the way ahead.

Accompanied by Wiederkehr, I went out to solve the problem of an "easterly passage." Our first surprise was to find that the creek fell into the left bank of what might fairly be termed a river, only a quarter of a mile below our camp. Our next, and much greater, was to find that this river, coming from the comparatively low country on the west, ran full tilt at, and breached through the range which we had vainly tried to cross. It had a rocky bed, with magnificent waterholes. It ran to the south for about a mile, when it was met by a large tributary coming from the south. It then entered the range by an incredibly narrow gorge and forced its way to the east. We had to leave the river above the gorge, and after circling round by the hill-tops on the left bank of the tributary, cross the latter (large waterholes and rocky, impassible gorges) and ascend the hills on the south side of the river—a journey of about six miles—before we could regain the river, about two miles below the first gorge. We crossed the river at a very romantic spot. On either side a little patch of green had been formed by the mouths of tributary gullies, while both above and below the river contracted to a cañon, with, apparently, unfathomable depths of blue water standing between precipitous walls of rock. This, one of the most picturesque scenes in Australia, can, however, have been rarely visited by white men.

I had seen so few traces of the aboriginal inhabitants of the soil between the Gregory and the Leichhardt that I had frequently asked myself the question—"What does he do with himself?" But from what we saw to-day, I have no doubt that this cañon is one of his chosen haunts.

From the river we returned in about three miles, over stony hill-tops, to the camp.

The whole of the hills we saw to-day—and I believe they are a fair sample of the range generally—are of white sandstone, nearly vertical or dipping slightly to the west. They are hardened, but not otherwise much altered.

For to-morrow I can see no better course than to cross the hills north of the gorge, and to drop down on the river, below the place where I could see it apparently escaping from the range for the last time and running to the NE.

November 27th.—We carried out the plan referred to yesterday—if it could be called a plan. By 11 o'clock we had accomplished about five miles of the very roughest possible travelling in a general ENE. direction, over hill-tops and gullies, and found ourselves on the left bank of the river, in open country below the last of the gorges.

After a halt to refresh the horses, we ran the river down for about three miles in a general ENE. direction till it had got clear of the hills on the right bank, when we left it, and struck for the Leichhardt.

This river must be Mistake Creek, which falls into Gunpowder Creek about three miles from the junction of the latter with the Leichhardt.

After about seven miles travelling to the east, through open, well-grassed country, we crossed a low divide, crowned with scrub. Two miles further we crossed Eureka Creek, and ran it down for a mile to the NE., but finding no water, left it, and reached the Leichhardt in one mile more to the east (Limestone Downs). We camped on the river near the 31-mile tree, about two miles below the grass gunyah referred to in my last report.

I may say, in general terms, that I was not favourably impressed with the chance of mineral traffic for the railway arising from the country I had traversed between the Gregory and the Leichhardt. I do not doubt that the strata are of the same geological age as those of the Cloncurry, Dugald, and Upper Leichhardt, but pure siliceous sandstones bulk too largely in the ranges. The slates are, as a rule, not ferruginous enough. Quartz reefs are too rare, and the intrusive diorites and vast deposits of ironstone which characterise the Cloncurry district are conspicuous by their almost entire absence. In a word, the strata have not undergone a sufficient degree of metamorphism to render them very highly metalliferous.

Had there been time enough at my disposal, however, I could have wished to examine more minutely the district between the O'Shannessy and Police Creek, as well as the country from the left bank of Gunpowder Creek to the heads of Spring Creek. In the first-named district, the numerous outcrops of manganese ore, and occasional appearance of gossan, at least warrant further search for other metallic deposits. In the other region, the prevalence of ferruginous slates, the frequency of quartz reefs, and the occurrence of specular iron ore, led me to believe in the presence of gold, and possibly of ores of other metals.

November 28th.—We travelled by the road up the Leichhardt to Cooloolah (Mr. Collis' station), a distance of 22 miles. Another of the horses is now scarcely able to walk, and as we have no spare horses, the failure of one implies the overloading of another.

The road traverses good open pastoral country up to Cooloolah. A range, however (of which a hint is given in the published map, in the single peak named Mount Dromedary), is visible a few miles to the east.

November 29th.—At Cooloolah we rested the horses for the day; I expected besides to be able to buy some fresh ones from Mr. Collis, but was disappointed in this, as he failed to find the horses he proposed to sell.

November 30th.—Left Cooloolah. In nine miles the road, which had followed the left bank of the Leichhardt, crossed the river at the mouth of Cabbage Tree Creek, and ran up the right bank for a mile and a quarter to our old camp, beside Mr. Walsh's station. As there was no water between the Leichhardt and the Dugald—a distance of 20 miles—we gave the horses four hours at the Leichhardt.

For four miles from Walsh's station the track goes SSE. till it crosses Cabbage Tree Creek, when it strikes about 10 degrees south of east. For the first 12 miles we crossed low ridges—quartzite, porphyry, and slate, with a good deal of quartz. This country extends northward (*via* Mount Dromedary) for a long distance between the Leichhardt and Cloncurry Rivers, and has never been prospected, as far as I can hear.

The last eight miles to the Dugald were over open country with "plains," evidently belonging to the "Downs" formation.

Two of our horses were knocking up, and but for the kindness of Mr. Bell, a rheumatic invalid, who was travelling with us from Cooloolah to Cloncurry, in allowing his packhorse to carry some of our load, I doubt if we should have reached the Dugald.

At the Dugald (about two miles below Mr. Walsh's station), we got water in a hole in the sand which had been excavated by a bullock scoop.

December 1st.—It was my intention to have pushed on to-day to the Williams River (20 miles), so as to catch the mailman to-morrow at Fort Constantine, and communicate with General Feilding. When we got to Middle Creek, however (10 miles east 10 degrees south), it was evident that our horses could go no further. Luckily there was water in Middle Creek. In the afternoon there was a terrific gale, with thunderstorm and hailstorm. The hail lasted for some minutes, and the stones were as large as marbles—a very unusual experience in the tropics.

December 2nd.—Mr. Bell having kindly lent me his own horse, I pushed on to Fort Constantine, leaving the men to bring on the packhorses by easy stages. In 10 miles (east 10 degrees south) I reached Clonagh, Mr. Reid's station, on the Williams River. The banks of the Dugald, Middle Creek and the Williams exposed sections of specular iron ore and calcareous sandstone with echinus spines, etc. The country from the Dugald to the Williams is good enough to carry sheep if dams were provided.

From Clonagh I steered across the bush to the SE., and in five miles struck the Cloncurry River. Keeping the right bank of the river, I reached Fort Constantine in about 20 miles.

I arrived at Cloncurry (18 miles) on the following day (3rd December). The packhorses covered the distance (50 miles) from Middle Creek to their old camp at the Cloncurry in four days, and arrived on the 5th instant.

Cloncurry, 8th December, 1881. ROBERT L. JACK.

FOURTH REPORT

(SEE FOUR-MILE MAP, No. 1).

Great Australian Copper Mine.

Lode A.—The most conspicuous feature of the mine is the outcrop of a lode, which runs north 33 degrees west, and stands up to an average height of about 20 feet above the general level, for about 80 yards. The lode underlies to west 33 degrees south, at an angle of 50 degrees. The matrix is a brownish quartzite, very tough and hard, and frequently enclosing small pieces of native copper, interspersed through the matrix irregularly; but as a rule, in veins parallel to the general run of the lode, are masses of green carbonate of copper and red oxide, the latter often in crystals, and as nearly as may be, chemically pure. The ore has been quarried to a small extent on the crown and south-western side of the hill. If the whole hill were quarried out I believe that on a rough estimate quite a fourth of the entire mass would yield ore containing 35 per cent. of copper and over, after the rejection of the siliceous matrix and portions of ore too much mixed up with the matrix.

Lode B.—At the SE. end of the hill the A lode is shifted about 90 feet to the SW. by a cross lode (B) whose course is east 40 degrees north. This cross lode is traceable for over 100 yards to the NE. of the lode A, but the first 20 feet or so are obscured by a talus of debris from the outcrop of lode A. Lode B is nearly vertical, but underlies a little to north 40 degrees

west. Its most conspicuous feature is a rock, 32 feet in length, 8 feet broad, and averaging 6 feet in height. This rock is a mass of quartzite like that which forms the matrix of lode A, and has joints and pockets coated with green carbonate of copper. To west 40 degrees south of the rock and in the same line, the cap of an ironstone and copper lode extends for 17 feet, when it passes under the talus already referred to. At the other end of the rock (to east 40 degrees north), the lode is traceable, either *in situ* or in blocks, for 260 feet. Lode B occurs in a line of fault with a downthrow to the north, and is of later date than lode A.

To the south of lode B, lode A is continued in a general direction of south 10 degrees east, for a distance of about 24 yards. It appears here to be narrower and poorer (at the outcrop) than on the other side of the cross lode, and to bifurcate towards the south end.

Lode C.—The south end of this (which may be called the second section of lode A), is intersected by a second cross lode (lode C) running east 35 degrees north. This lode has been worked open-cast for about 110 feet to east 35 degrees north from the crossing of lode A. The ground rises in this direction, and the present face of the working is about 20 feet high. The lode varies from 2 to 12 feet in width and is nearly vertical. The faces and sides of the workings expose masses of red oxide of copper of great purity, often intimately mixed with small nuggets of native copper. Occasional crystals of black oxide of copper are met with in this cutting. The oxide is traceable for a considerable distance beyond the working.

What may be called the third section of lode A extends in a general direction of south 15 degrees east from lode C. It has been worked open-cast for about 50 feet from the crossing of lode C, and has yielded much rich ore. The south face of the open cast shows a mass of very pure red oxide bound together by masses of native copper.

From this open-cast no work has been done for the next nineteen feet (though the lode is visible on the surface), when an underlie shaft has been sunk on it, in rich ore. The lode is untouched for about 40 feet from the shaft, when it is again worked open-cast for a distance of 90 feet. The workings here have tumbled in, but enough is still seen to prove that the lode continues undiminished in size, and yields rich oxide ores.

About 250 yards to the SE. of this cutting is Mount Pisa, a hill of iron ore, very like that of Mount Leviathan (see First Report), although not rising into such an enormous mass.

About two miles north of the Great Australian is a group of copper lodes, which I think are destined to become of more importance than they seem at present to be considered. They occur on the crown of a little spinifex-covered hill. The main or central lode runs NE. and SW., pointing in the latter direction to Mount Leviathan. It may be remarked here that this case, the relation of the Great Australian lodes and Mount Pisa, and many other cases in the district, suggest that an intimate connection exists between the copper lodes and the ironstone mountain masses.

The main or central lode begins (so far as can be seen) at its NE. end, in a knob of tough quartzite, very like the matrix of the Great Australian. The knob is about 12 feet high, and is coated on joints and faces with green carbonate of copper. From the knob the cap of this lode is visible for 293 yards to the SW. It generally presents the appearance either of a quartz reef, or of a breccia of quartz and hæmatite, with some green carbonate and

lumps of red oxide of copper. About 120 feet from the knob a shaft has been sunk to the depth of about 30 feet. The lode has a slight underlie to the NW. About two tons of ore are lying at bank, including some good red oxide with native copper, some grey ore, and a little copper pyrites.

Some 323 feet from the SW. end of the main lode, a second lode branches off on the SE. side. It forms a very acute angle with the main lode, being only 60 feet distant from the knob at the end of the latter (bearing south 15 degrees east), at the point where it is last seen. The cap differs very little in character from that of the main lode.

150 feet north 30 degrees west from the junction of the two last mentioned lodes, a third lode commences. It is traceable for 230 feet to east 10 degrees north. Its cap is a breccia of quartz and ironstone with a few stains of green carbonate of copper. Three other lodes occur to the north of this. Two of them run WSW., and the third NE. They are masses of tough buff-coloured quartzite, varying here and there to ferruginous and quartzose lodes, with lumps of green carbonate of copper and some grey ore. The lodes on the NW. of the central lode, in all probability join the latter to the SW. of the knob.

Rockwood, 15 January, 1882.

FIFTH REPORT

(SEE FOUR-MILE MAP, No. 1.)

The Gilded Rose Gold Mine lies at the head of Bishop's Creek, about eight miles east of the Cloncurry Native Police Camp. The reef runs east 10 degrees south, and underlies to south 10 degrees west at 75 degrees. It is traceable for nearly half a mile. Its line coincides with the strike of the bedded rocks which occur in the immediate neighbourhood—viz., flaggy talcose sandstones and shales. The quartz occurs in blocks of from 10 inches to 3 feet across, and is coated and veined at the surface with iron peroxide and limonite. From the lower levels (which I was unable to visit owing to the stoppage of the works, and consequent accumulation of water), large quantities of pyritous mundic have been mined, and the stone is said to yield 2 oz. of gold to the ton. The mine has been registered since 25th November last, to enable the proprietors to obtain machinery. The present plant is certainly very imperfect.

The greater part of the space from the Gilded Rose south-westward towards Snake Creek is occupied by a low range of slate and greywacke rocks, with at least one thick bed of grey crystalline limestone, containing chloride, and weathering black. These rocks have a general strike to the NNW. They are intersected by numerous quartz reefs and leaders, some of which, I believe, would pay well to work.

Mountain Home.—Mount Norma lies about 10 miles SE. of the Gilded Rose. It is a very conspicuous hill, especially as seen from the Hughenden road. It is of vertical slate (or rather shale) with a NW. strike, and is intersected with reefs or veins of quartzite. On its eastern side is the Mountain Home Copper Mine. The mine is one of the quartzite reefs above referred to, which runs NNW. and is almost vertical, but has a slight

underlie to ENE. The reef is seamed with copper ore, especially in the back (up hill). In the upper part of the lode, where the reef stands up like a wall on the hill side, the copper ore is represented by stains (stalactitic coatings) of green carbonate. The lode is a peculiar one in many respects, from the association of minerals. It yields green carbonate of copper, ferruginous red oxide of copper, enclosing numerous garnets, asbolane (manganese and cobalt) and numerous dendritic markings in binoxide of manganese.

From the hardness and toughness of the siliceous matrix of the ore, the Mountain Home will probably be an expensive mine to work, but I should expect it to have a large output of ore of good quality. The labour conditions necessary for securing the land have been fulfilled for the most part by the construction of a dray road up the hill; and the mine is very little opened out.

From the summit of Mount Norma, horizontal outliers of "Desert Sandstone" are seen to extend from the Soldier's Cap (six miles SE. of Mount Norma) north-westward towards the Cloncurry.

I was much struck by the aspect of the country between the Gilded Rose and the Mountain Home. The rocks were of sedimentary origin—mainly quartzite, bluish hardened quartzoze greywacke, and dark slate, with occasional diorite masses. They were full of quartz reefs, and blocks of black ironstone were everywhere scattered about. On breaking some of these boulders, about halfway between the Gilded Rose and Mount Norma, I found them to be masses of green carbonate of copper enclosed in an envelope of black ironstone. I expect that many copper lodes and auriferous reefs remain to be discovered in this district.

On Weatherley Creek, about three miles north of the Soldier's Cap, a reef is being worked. Its matrix is quartz and calcite. There is no machinery on the ground at present, but the rubble of the casing of the reef yields 2 oz. of gold to the ton steadily, and the owners are doing very well. When machinery arrives several other reefs in the neighbourhood will be taken up and worked. I did not visit Weatherley's Reef, but the above particulars are given on what I believe to be reliable authority.

Elder Creek rises at Mount Norma, and runs north-westward into the Williams River. Six miles down the creek some good prospects of gold have been obtained in gullies falling into the left bank.

On making inquiries as to water between the Cloncurry and Winton, that the country was about at its worst, there having been no rain months except in very local showers. The usual route up the iver and Mackinlay Creek to Beaudesert, and thence to Belkate on entina, was practically closed for the season. I determined to go n Creek, where there had been some little rain.

ad camped, on the night of 20th December, on the Gilliatt River, is crossed by the Hughenden road.* The waterhole had fallen e, about 10 feet in diameter, and when we arrived we found it in of a large mob of cattle. After the water had been boiled twice, ned and decanted, it was good enough to make tea with.† The

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16-Mile Map.

† notes are introduced which are not strictly geological, as I fancy that a true picture of the western interior at the end of a dry season must possess some interest for the of the railway.

horses, however, could not be expected to like it, and on the 21st, five of them were missing. They were not found till 4 o'clock. I thought we could reach the Eight-mile Waterhole on Eastern Creek (distant about eight miles from our camp) before dark. We struck Eastern Creek just after sunset, about two miles below the Eight-mile Waterhole. In creeks in the "downs" it is very hard to tell which is the main channel, and we unfortunately selected one of the mouths of a tributary called Sadowa Creek. Finding no water in this, and in the belief that we were running up Eastern Creek, we followed Sadowa Creek for 9½ miles in the dark, when we had to camp (at eleven o'clock at night) without water.

In the early morning of next day we packed up and retraced our steps. We found in Eastern Creek, a little above its junction with Sadowa Creek, a waterhole (surveyor's tree, broad-arrow 33), which we afterwards found out to be the lower part of Eight-mile Waterhole, but far separated by the drought from the upper part. The hole was very small. The water could not last another week, and a wide border of treacherous clay surrounded it. A large mob of cattle were crowded on the banks, but the animals only ventured in, one by one, after they had become fairly maddened by thirst. Then they had a struggle for life in getting out. Four head of cattle were hopelessly bogged—alive, but doomed to death. We tied all the horses up, and watered them with the tin dishes.

We had next to run Eastern Creek down (eight miles) to Eddington Station, which was the nearest place where water was certain, and we did not dare to camp the horses beside the boggy waterhole.

On the 24th we again started to run up Eastern Creek. We found the Eight-mile Waterhole to be about two miles above the boggy hole at the 33-mile tree. In the latter four more cattle had got bogged.

Thirteen miles further we passed another waterhole, but it was far too boggy to water the horses. In five miles more we camped on a little waterhole (near the 53-mile tree) apparently due to recent rain.

On Christmas Day we passed a waterhole at 2½ miles, but it was dangerously boggy. At 5½ miles and 11½ miles we passed two waterholes with stony bottoms and quite safe. At 20½ miles we camped on a fourth waterhole.

The next day (26th) we followed the creek up for 19 miles without seeing any water, when, as the heat was terrible, and one of the horses was knocking up, we camped for a time. All the water we had seen in Eastern Creek above the Eight-mile Waterhole had been due to recent rain, which had apparently not extended beyond the limits of our yesterday's journey.

After seven more miles of travelling, mainly south—the creek having in the meantime run out—we camped (still without water) on the open downs to rest, as several horses were now quite exhausted. We packed up again just before sunset, and in ten miles reached the Diamentina, and camped on a waterhole about a mile and a-half below Kynoona.

The strata met with between Eddington and Kynoona appeared to be on the whole horizontal, and consisted of grey and buff sandstones, grey shales and cone-in-cone limestone. The latter became more and more rare the further we travelled to the south. The sandstone sometimes contained echinus spines. The whole of the country was open rolling downs, quite bare of timber except in the beds of the creeks. The divide between the waters falling into the Gulf of Carpentaria and others which flow to the south was quite imperceptible.

The following day had to be devoted to mapping, while the horses recruited their strength.

On 28th December we followed the Diamentina down by the road on its right bank. We passed a waterhole at eight miles. At 16 miles we passed a new sheep fence, remarkable as being at present the furthest west permanent improvement of the sort on the Upper Diamentina. At 25 miles we camped on a waterhole on the right bank of the river.

Kerr's Tableland, seen in the distance in the early part of the day, looked like slate with an unconformable capping of horizontal sandstone. Pinnacle Hill, Mount Cathedral, and the Giant's Table were seen, but the heat was intense, and the hills were so distorted by mirage that I could make out nothing of their structure.

The road kept for the greater portion of the day on the alluvial flats of the river. Whenever the rock was seen it was a soft grey or buff sandstone. Sometimes the ground was strewn with large little-rounded pebbles of tough quartzite—occasionally inclining to opalization—and smaller and better rounded pebbles of sandy-brown iron ore. Quartzite of this variety occurs *in situ* in the Lancewood Range and the tableland east of the Landsborough. It is desert sandstone somewhat altered. The pebbles attest the denudation of the Desert Sandstone from vast areas where the downs formation now happily comes to the surface.

December 29th.—In six miles we passed a waterhole, and crossed the Diamentina at a waterhole, the site of old Dagworth Station. The present station is on the left bank of the river some miles further up. In five miles more we camped on a waterhole in Watt's Creek, near its junction with the Diamentina. A hut is being erected here for an out-[illegible] on Elderslie run.

[illegible] his day's journey sandstones predominated, and they became [illegible] grain and greyer, towards Watt's Creek. Grey sandy shales [illegible] ied the sandstone. A little silicified wood was seen.

[illegible] the 30th we travelled by the road from Watt's Creek to the Downs on Wokingham Creek, a distance of 30 miles. There was [illegible] on the road, but I was informed that some was to be found in the [illegible] wood Range.

[illegible] ween the Diamentina and Wokingham Creek the road passes over [illegible] downs. The prevalent rocks were grey sandstones, with a good [illegible] undy ironstone or ironmasked sandstone. A good deal of silicified [illegible] seen lying on the surface. A peculiar feature of the sandstone is [illegible] rrence of spheroidal concretions of all sizes up to six feet in [illegible]

[illegible] Lancewood Range consists mainly of a single thick horizontal bed [illegible] partly gritty white hardened sandstone, and partly white hardened [illegible] is a slightly altered outlying fragment of the Desert Sandstone.

[illegible] *mber* 31.—Accompanied by Mr. Glissan, the manager of Ayrshire [illegible] nd Mr. Mitchell, of Werna,† I visited a well on the boundary of the [illegible] runs.

[illegible] well was sunk in 1879, to the depth of 204 feet, where it was [illegible] in a bed of fine-grained hard grey sandstone. The strata

ould have added that the lines of stratification go clean through the concretions, and are even when the latter are weathered out and lying on the surface.—R.L.J., 1898.

na Station is on Wokingham Creek, 10 miles above Ayrshire Downs. In the Lands Office correctly located on Werna Creek.

passed through were principally grey sandstones and sandy shales; a bed of argillaceous sandstone with shells was passed through, and lumps of silicified and carbonised wood were dug up from various depths. A first seam of coal, three or four inches thick, was cut at about 140 feet; a little water came in just below. A second thin coal seam was passed, somewhere between 140 and 180 feet; more water came in at 180 feet. At present the water is 70 feet deep; but it comes in very slowly, and is not sufficient for stock-watering purposes. It would be worth while at least, before abandoning a work which must already have cost a good deal of money, to pierce the hard compact bed at the bottom of the well, as there is a strong probability that any such stratum overlying a more pervious rock may be the lid of a copious water-supply.

In the heap of debris excavated from the well, I found fragments of small seams of coal, lustrous and brittle, alternating with layers of dull black carbonaceous shale.

After visiting this well I went on to Werna Creek, 10 miles SW. of Ayrshire Downs, whither my camp had been sent in the morning.

It may be mentioned here that a well has recently been sunk at Sesbania Station, on the head of Wokingham Creek, to the depth of 212 feet.* No coal was found, and very little water. On 1st January, 1882, we came to Winton (30 miles) crossing Dry Creek, Cockatoo Creek, and some others; but without seeing any water. Between this road and Mills' Creek is the little tableland, known as Wallace's Ranges, evidently an outlier of somewhat altered Desert Sandstone, like the Lancewood table-land near Ayrshire Downs.

On the following day I visited the well which is being sunk by the Government, behind the court-house. That this is a highly necessary work will be understood, when I say that the town depends entirely on a waterhole in Mistake Creek, two miles distant. The waterhole (which is narrow) at the date of my visit had shrunk up to about 400 yards in length, and was said to be eight feet deep at the deepest point. It was expected that it might stand the demands made on it for three weeks or a month longer, when, if the drought still remained unbroken, the population of Winton would have to migrate in a body to Conn's Waterholes, with their flocks and herds. Nearly a month has elapsed since then and the wet season has not yet set in on the coast; if there has been no local rain, I fear the waterhole must by this time be very low.

I went down the shaft, which was then about 150 feet deep. The work had been suspended for some days owing to the sudden death of the contractor. There were only a few inches of water standing in the bottom. The well is to be sunk to 200 feet.†

One thing I was specially anxious to ascertain at Winton was whether the coal seams discovered in sinking wells in that neighbourhood were of the same (palæozoic) age as the coal-fields of the Bowen River, Queensland, and Newcastle, New South Wales, or whether they were part of the mezozoic rocks of the Downs. In the former case there would be a guarantee for their quality and value, but on the other hand a likelihood of their being of

* A bore has since been put down on Sesbania run. Water was met with at 2,300 feet. It flows at the rate of 1,000,000 gallons per day.

† A bore has since been put down at Winton to a depth of 4,010 feet, and artesian water flows at the rate of 1,000,000 gallons per day.

comparatively limited extent, owing to the denudation which must have taken place previous to their being covered by the newer rocks of the "Downs" formation. In the latter case there would be every reason to expect that the coal might be found over an immense area, but there would be everything to learn from experience regarding the quality of the coal, and its occurrence or non-occurrence in beds of workable thickness.

The greater part of the shaft was slabbed up; and owing to the death of the contractor I could not obtain any record of the different strata passed through, but I was informed that a coal seam, 15 inches thick, was passed through at 70 feet, and another at about 100 feet. At the bottom of the shaft (150 feet), where it was still unslabbed, I saw horizontal strata of sandy shale, unquestionably of the "Downs" formation, and easily distinguishable from the Coal Measures proper. The question was thus solved, as the two coal seams occurred at the respective depths of 70 and 100 feet.

The coal seams were 15 inches and 2 feet in thickness respectively.* From the fragments I picked up in the heap of rubbish at the mouth of the shaft, I should say that the coal occurs in thin layers among dark carbonaceous shales. The attempt to burn the shale and coal together generally results in disappointment, and the idea prevails at Winton that the coal will not burn. Treated alone, however, with the blow pipe, I found that the coal burned very well. The specimens I carried with me are coming on with my horses. I must postpone till their arrival, further remarks on the quality of the coal, as I could not analyse it in the bush.

The strata passed through in the well consist mainly (so far as I could judge from an examination of the rubbish heap), of soft grey sandy shales with a few beds of blue-grey sandstone. The sandstone occasionally contains nodules of pale pyrites (marcasite), and sandstone and shale alike are full of carbonaceous plant impressions. The latter were, however, all so imperfect that I could make out no structure in them. Blocks of silicified wood were found at all depths in the shaft.

From Mr. Julius von Berger I received the following particulars of a well, known as "Sheppard's," or "The Butcher's," sunk in lot 7, of section 1, in the township of Winton:—

	Feet	in.
Alluvial layer (yellowish sandy, with a few seams of carbonaceous ash)	40	0
Coaly shale	0	0½
Second alluvial layer	40	0
Coal seam	0	7
Third alluvial layer (compact clay shale with pieces of jet and lanceolate leaves; in the middle of the layer a bed of shells)	40	0
Coal seam	2	0
Hard alluvial clay	13	0

No water supply was obtained in this well.

On 3rd January I visited Vindex Station, and saw the well (on which a windmill has been erected), sunk two years ago. The station had changed hands since then, and the new owners could give little information regarding

* I had much difficulty in obtaining the above figures. Opinions, especially unprofessional ones, would naturally differ as to how much was coal and how much shale.

of Cretaceous aspect, and saw many more of the genus *Inoceramus*, too large for transport.

Almost the whole of the country I passed over between Eddington and Rockwood is suitable for sheep, as far as grass is concerned; but a great part of it is unavailable owing to the distance from permanent water. Matters are improving, however, in this respect, as numerous dams have been constructed, and only wait for the next rain to fill them up, while many wells will be sunk in the course of next year.*

Till the collection of fossils has been worked over, it would be worse than useless to attempt to define too closely the age of the downs. It is enough for me to say in the meantime that the whole of the downs consist of one unbroken series which will probably turn out to be homotaxial with the Oolitic or Cretaceous rocks of Europe.†

The downs, in spite of their rolling, have a nearly level surface. The strata are very nearly horizontal, and natural sections are rare, so that it is very difficult to form an idea of the stratigraphical relations of the different rocks whose outcrops are seen at long intervals. One broad distinction is, however, easily made:—

From Hughenden westward by the Cloncurry road, as far as the downs extend—viz., to the Williams River, the strata consist mainly of brown and grey sandstones, and grey shales, with thin layers of limestone with cone-in-cone structure. The sandstones yield abundance of mollusca, echinus spines, belemnite, fish-teeth, and other fossils—all of marine types. Plant remains, either in the form of carbonaceous impressions or silicified wood, are very rare.

In running up Eastern Creek and down the Diamentina, the limestones become rarer and rarer. Echinus spines and belemnites still occur sparsely in the sandstones, nearly to the head of Eastern Creek, but the abundant marine life of the Flinders valley disappears—so far as my observations went—and in its place, in the Diamentina basin, we have numerous carbonaceous plant impressions and silicified trunks and branches of trees. What few shells there are are fresh-water forms. In short, a broad distinction can be drawn between the fresh-water and the marine area of the downs. The fresh-water series is disclosed in wells at Ayrshire Downs, on Wokingham Creek, at Winton and Vindex, on the Western River, and at Manuka. The marine fossils reappear in Rockwood Creek, and continue eastward to the head of Jirking Creek, where the downs formation passes under the Desert Sandstone to be seen no more.

The coal seams hitherto discovered in sinking wells are all comprised within the area in which the fresh-water series comes to the surface.

The area in question would be, roughly speaking, comprised within the line which forms the northern and eastern boundary of the division named Ayrshire, from the longitude of Kynoona to the latitude of Winton. I cannot from my own observation continue the eastern boundary of the carboniferous area further south, but I learn, from hints in the writings of Daintree and Clarke, and from private information, that marine secondary fossils have been obtained at Tower Hill, Bowen Downs, Aramac, and various places down the Thompson River, I imagine that the line will run to the west of the Landsborough and Thompson, probably somewhere about the Darr River.

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* Artesian water has since greatly altered and improved the aspect of affairs.—R.L.J., 1898.

† We now class the "Rolling Downs" formation as Cretaceous.—R.L.J., 1898.

Let me sum up briefly what we now know of the downs coal beds.

The downs consist of a great thickness of strata of secondary age, which are capable of subdivision into a marine and fresh-water series.

The known coal seams are all included in the area where the fresh-water series makes its appearance at the surface.

So far as my observations have enabled me to fix it, the limit of the area in question nearly coincides with the line which bounds Ayrshire on the north and east from Kynoona to the head of the Western River.

My belief is that the fresh-water series overlies the marine, occupying the axis of a very wide synclinal trough. I should not, however, be greatly surprised to learn that I am mistaken, the difficulty in making out the stratigraphical relations of such a deposit being, as I have said before, very great, and my examination of the district far from minute enough to settle a question of such importance.

If I am right, the limit of the carboniferous area will be that of the fresh-water series. If, on the other hand, the fresh-water series should turn out to underlie the marine, its area will be co-extensive with that of the downs, but the thickness of the marine strata will probably be found in many instances too great to allow of profitable working.

If it cannot be said that any payable coal seams have yet been discovered in the downs, it may be said on the other hand that we know nothing to discourage the hope that they may shortly be found. No direct search has been made for coal, and there is nothing to cause surprise if no payable seam as yet been laid bare by the half-dozen or so wells which have been sunk in such a large area.

In any other part of the world such indications of coal as are here presented—a wide-spread undisturbed and unaltered formation, full of plant remains which have been proved to collect into coal seams in several places where they were accidentally discovered in sinking wells—would be eagerly and hopefully followed.

The "Jump Up" at the head of Jirking Creek takes us at once up to the top of the tableland of "Desert Sandstone" which lies unconformably on the downs formation. The ascent is not more than fifty feet. The base of the sandstone as seen at the "Jump Up" is highly ferruginous and apparently of volcanic origin. The immediately succeeding beds are of tough hardened sandstone or quartzite—the material of which pebbles are scattered all over the downs. The tableland extends north-eastward to the Campaspe River and is so flat that it seems a dead level to the naked eye
here streams intersect it. Sections of the rock are consequently
. Some gritty beef-coloured sandstones and thin plates of yellow
nstone were seen eight miles below the upper crossing of Amelia

would be of the utmost importance to the projectors of a
inental railway to have the western edge of the Desert Sandstone
. mapped in, for here alone in the neighbourhood of the line is
ber available for sleepers and bridges. The "desert" is thickly
with ironbark, bloodwood, box and gum.

reached the Campaspe River, 35 miles from Charters Towers, on
uary. I rode on the following day to Charters Towers, and on

the 26th, came by coach and rail to Townsville. The horses are following slowly in charge of Wiederkehr and Martin.

On the arrival of my specimens by the packhorses I shall send a further report on the quality of the coal.

ROBERT L. JACK.

Townsville, 28th January, 1882.

SIXTH REPORT.

The following tables give the results of rough analyses of the three samples of coal brought from the neighbourhood of Winton, and there are added for comparison details of the analyses of certain Scotch and American coals of somewhat similar composition.

	(1) *Government Well, Winton.*	*Kanawha, Ohio.*
Carbon	52·49	52·75
Volatile	42·93	43·20
Ash	4·58	4·05
	100·00	100·00

	(2) *Sheppard's Well, Winton.*
Carbon	30·32
Volatile	49·34
Ash	20·34
	100·00

	(3) *Well, 3 miles SE. of Werna.*	*Lesmahagow Cannel.*
Carbon	39·07	39 40
Volatile	55.96	56·60
Ash	4·97	4·00
	100·00	100·00

The coal from the Winton Government Well has a laminated structure, and is very apt, not only to split up along the laminæ, but also to break in joints. It contains 52·49 per cent. of fried carbon, 42·93 per cent of volatile hydrocarbons, and 4·58 per cent. of ash. Such a coal might be used as a furnace coal; and if a less fragile seam could be met with, it might even be employed in its raw state, as in burning it swells very little, and does not cake at all. The coke made from my samples was hard and rather compact, although it still showed the laminated structure peculiar to the coal.

The coal from Sheppard's Well, Winton, contains nearly 7 per cent. more of volatile matter than that of the Government Well, but its large amount of incombustible ash (20·34 per cent.) places it almost out of the category of coals. It is dull, and very distinctly laminated.

The coal from the well three miles SE. of Werna (on the boundary of Ayrshire Downs) bears a close resemblance in composition to the famous Lesmahagow coal, although it is brighter and more lustrous on cross fractures. It does not soil the fingers. The samples I was able to gather had lain exposed to the weather for two years, and must have lost some of the volatile matter. The coal occurred, so far as I could learn, in very thin seams. A thicker seam of similar quality would possess high value for the manufacture of illuminating gas, and for household use in the vast untimbered downs where firewood will soon be an almost unattainable luxury. The coke of the Werna coal is hard and a little spongy, and would serve well for furnaces and locomotives.

A geological sketch map is sent herewith. It embraces the whole of the district traversed by me, from Gregory Downs to Rockwood.

The Lands Office map, on the scale of eight miles to the inch, has been taken as the basis of the sketch map. The geography of the district has required much correction, especially in the neighbourhood of the Leichhardt. Where these corrections have not been made, some distortion of the route and other lines results from the attempt to connect them with the incorrect geography of the map.

The larger scale map which accompanied my previous reports may be referred to for more correct topographical details, as well as for the various known mineral localities.

It will be observed that metamorphosed rocks—slates, greywackes, quartzites, and limestones—with occasional small patches of granite and diorite, extend from the head of the Mackinlay River north-westward to the Gregory. The whole of the gold, bismuth, copper, antimony, lead, manganese, and iron deposits occur within this area. A railway from Point Parker up the Leichhardt to the Cloncurry township would people that rich district with an active mining population, and attract a remunerative mineral traffic. The connection of Cloncurry with the Hughenden and Townsville Railway would not serve quite the same purpose, as such a railway would have to be extended north-westward to the Leichhardt, near St. Paul's Creek, to receive the traffic which the Point Parker line would pick up by the way.

The age of the metamorphic area is undetermined at present. Some corals* were obtained from Mount Eurie, near the head of the Dugald, but they were not in such a state of preservation as to be even generically identifiable. My impression is that the metamorphic area in question is not of the same age as any of the gold-fields or mineral areas in the south and [illegible] colony. Practically, however, the solution of this question can [illegible] the presence of rich mineral deposits is undeniable.

[illegible] t in point of age comes the limestone of the Barkly tableland. It [illegible] ontally and unconformably on the upturned and denuded edges of [illegible] s, &c. It is unfossiliferous, so far as I had an opportunity of [illegible] nd I do not think it is likely to prove very highly metalliferous.

[illegible] at I call, provisionally, the "Downs formation" covers the [illegible] part of the map. Its outcrop is marked by the presence of pastoral [illegible] the first order. Between Eddington and the edge of the Desert

* [illegible] proved on subsequent examination to be the mineral scapolite. See note to Second Report.

Sandstone near Rockwood, I travelled for about 300 miles over richly grassed land, almost every acre of which was suitable for sheep, storage of water being the only desideratum.

The Downs formation, although obviously one great and unbroken series, contains fossils of very different ages, ranging from low in the oolitic to high in the cretaceous rocks.* An examination of my collection of fossils will, it is to be hoped, throw some light on the age of this very important deposit.

Besides the carriage of wool from the Downs to the port, there is reason to hope that there may arise a traffic in minerals between the Leichhardt and Cloncurry districts and the Downs.

On referring to my map and fifth report it will be seen that the Downs formation is capable of subdivision into a marine and fresh-water series. My belief is that the latter overlies the former, but of this, owing to the scarcity of natural sections, I am not quite certain. In six wells sunk within the fresh-water area the presence of coal has been disclosed. Whether the coal will turn out to be confined to the fresh-water series I do not know, but at present all the evidence points that way, and it may be safer to assume that it is so.

From Kynoona to Manuka my route lay through the area occupied by the outcrop of the fresh-water series. I could not determine its exact limits, either in coming from the head of Eastern Creek to Kynoona, or in going from Manuka to Rockwood Creek, as both of the stages were traversed in the night owing to the scarcity of water. The boundary-line is therefore only approximate. The fresh-water series may however be said to extend, roughly speaking, from the head of Rockwood Creek, and it may be continuous along the proposed line of railway, at least as far as Tambo, where coal has lately been found.

The fact that coal of good quality, although not of workable thickness, has been found in the Downs gives rise to some considerations which concern the Syndicate.

That seams of workable thickness and quality will be found in the Downs I consider very likely. When the area over which the coal extends, and the thickness of the strata, are taken into account, there is nothing to cause disappointment in the fact that the few wells hitherto sunk have not pierced any workable seam. In the course of the present year well-sinking will be carried on on a large scale, and I am confident that some coal discoveries will be made.

Granting that Winton may become the centre of a coal-field, it may be interesting to consider how this would affect the traffic from the metalliferous districts of the Cloncurry and Leichhardt.

It is always more economical to carry the ore to the fuel than to carry the fuel to the ore, for the reason that the smelting of a given quantity of ore requires a much greater weight of fuel than of ore.†

On the completion of the railway, the comparative merits of smelting works at Winton and Point Parker will at once come into competition.

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* This view has not been borne out by subsequent palæontogical examination. R.L.J., 1898.

† The relative proportion of fuel to ore has, since the above was written, been very considerably reduced. The speculations which follow have now only a historical value. R.L.J., 1898.

The ore might go from Cloncurry to Point Parker (290 miles), there to be treated by coal brought by sea from the south, or it might go direct to collieries at Winton (210 miles).

The following are estimates (in round numbers) of the cost of smelting a ton of copper ore at the two places, so far as affected by the carriage.

Smelting Works at Winton.

After smelting a ton of ore at Winton, the product, say two cwt.,* of metal would have to be conveyed by rail to a port. There would be 500 miles of land carriage for the metal, from Winton to Point Parker. The distance from Winton to Hughenden is about 140 miles, and from Hughenden to Townsville by the Northern Railway (partly constructed) 240 miles. In all, 380 miles to port.

From Winton, *via* Darr and Emerald (Central Railway), to Rockhampton is about 520 miles. The advantage in point of distance as regards the smelted metal would be greatly in favour of a line in continuation of the Northern Railway, from Hughenden to Winton.

The freight of the ore to Winton, and of the metal from Winton to the two competing ports, may be estimated as follows :—

	£	s.	d.
(1.) *By Townsville* :—			
Carriage of 1 ton of ore from Cloncurry to Winton, 210 miles, at ¾d. per mile	0	13	1½
Carriage of 2cwt. of metal by rail from Winton to Townsville, 380 miles, at ¾d. per ton per mile..	0	2	4½
	0	15	6
(2.) *By Point Parker* :—			
Carriage of 1 ton of ore by railway from Cloncurry to Winton, 210 miles, at ¾d. per mile	0	13	1½
Carriage of 2cwt. of metal by rail from Winton to Point Parker, 500 miles, at ¾d. per ton per mile..	0	3	1½
	0	16	3

Smelting Works at Point Parker.

To the carriage of 1 ton of ore from Cloncurry to Point Parker, 290 miles, at ¾d. per mile.	0	18	1½
There would fall to be added the freight of the necessary coal from (say) Newcastle, New South Wales, costing at least ..	3	0	0
	£3	18	1½

The carriage by sea of the necessary coal to Point Parker would be so heavy an item that smelting works there could not compete with smelting works at Winton—that is, granting that suitable coal may be found at the latter place. Supposing that Winton were connected both with Townsville and Point Parker by railways, the difference in the freight of the smelted metal is not so great but that lighterage at one port or other might turn the scale.

* This quantity may seem low, considering the high percentage of the Cloncurry ore, but it must be remembered that for smelting purposes a proportion of poor ores must be carried to the furnace.

In the foregoing estimates, I have not made the current rates of railway carriage the basis of calculation, but rather such minimum rates as could only be brought about by competition. Whether the rates be high or low, however, the proportions by the different routes would be unaltered.

The newest formation on the map is the Desert Sandstone. East of Rockwood is the western edge of the main mass of the formation. It rests horizontally on the "Downs" formation. Its chief interest in the present connection lies in the fact that it forms a tableland, which is well timbered, and might afford an unlimited supply of sleepers and fencing material.

Outlying fragments of the Desert Sandstone rest alike on the Downs and on the older metamorphic rocks, attesting the former great extension of the formation. I had no time to devote to the question, but I saw reason to conjecture that this despised Desert Sandstone may yet be regarded with respect as a source of precious stones. The lower part of the formation, as seen on its western edge and in the outlying fragments to the west, is partly a volcanic ash and partly a hardened sandstone. The outliers in question owe their preservation to their superior hardness, induced by local volcanic action; and the production of the opals which are met with on the Downs probably was indirectly the result of the same cause.

ROBERT L. JACK.

Townsville, 1st March, 1882.

APPENDIX.

List of Fossils determined by Robert Etheridge, Jun., Esq., and Dr. Henry Woodward, F.R.S., both of the British Museum.

Flinders River, seven miles above Marathon Station.—*Aucella Hughendenensis* (formerly *A. Liversidgei*), R. Etheridge; *Inoceramus pernoides*, Etheridge; *Æschna Flindersiensis*, Woodward.

Flinders River, seven miles below Marathon Station.—*Inoceramus.*

Flinders River, three miles above Richmond Downs Station.—*Inoceramus Carsoni*, McCoy; *Inoceramus Sutherlandi*, McCoy; *Inoceramus*, 3rd species.

Flinders River, at Richmond Downs stockyard.—*Inoceramus.*

Flinders River, 13½ miles below Richmond Downs Station.—*Inoceramus Carsoni*, McCoy.

Flinders River, 21½ miles below Richmond Downs Station.—*Inoceramus Sutherlandi*, McCoy.

Neelia Creek, at the crossing of the Cloncurry road.—*Aucella Hughendenensis*, Etheridge.

Cloncurry Road, at Julia Creek.—*Natica;* fragment of a cephalopod.

Cloncurry Road, one mile west of Williams River.—*Belemnites.*

Cloncurry Road, eight miles west of Williams River.—*Inoceramus.*

Rockwood Station, Landsborough River.—*Inoceramus*; *Aucella Hughendenensis*, Etheridge; *Amusium sulcatellum*, Stoliczka (var.) *Pseudomonotis semiglobosa*, Stoliczka (var,); *Pseudomonotis Rockwoodensis*, Etheridge.

Stone Hut, Rockwood Creek, Landsborough River.—*Aucella Hughendenensis*, Etheridge; *Belemnites; Otodus*, fangs of tooth of; and sections of long spiral univalve shells.

Rockwood Creek, junction with Landsborough River; *Inoceramus*, young form.

Landsborough River, five and a-half miles NNW. of Rockwood Station; *Aucella Hughendenensis*, Etheridge; *Pecten.*

Landsborough River, near the head of Jirking Creek; *Pecten; Aucella Hughendenensis*, Etheridge.

Kamilaroy Station, Leichhardt River; *Belemnites; Otodus, appendiculatus*, Agassiz; small *vertebræ* of a teleostean fish; posterior costal-plate of a *Chelonian.*

Leichhardt River, nine miles from mouth of Gunpowder Creek; *Belemnites*; *Lamna* (portion of tooth); *Aucella Hughendenensis*, Etheridge.

Sheppard's Well, Winton; *Unio* (species 1).

[illegible] Well, Winton; *Unio* (species 2).

No. 136 of the Geological Survey publications.

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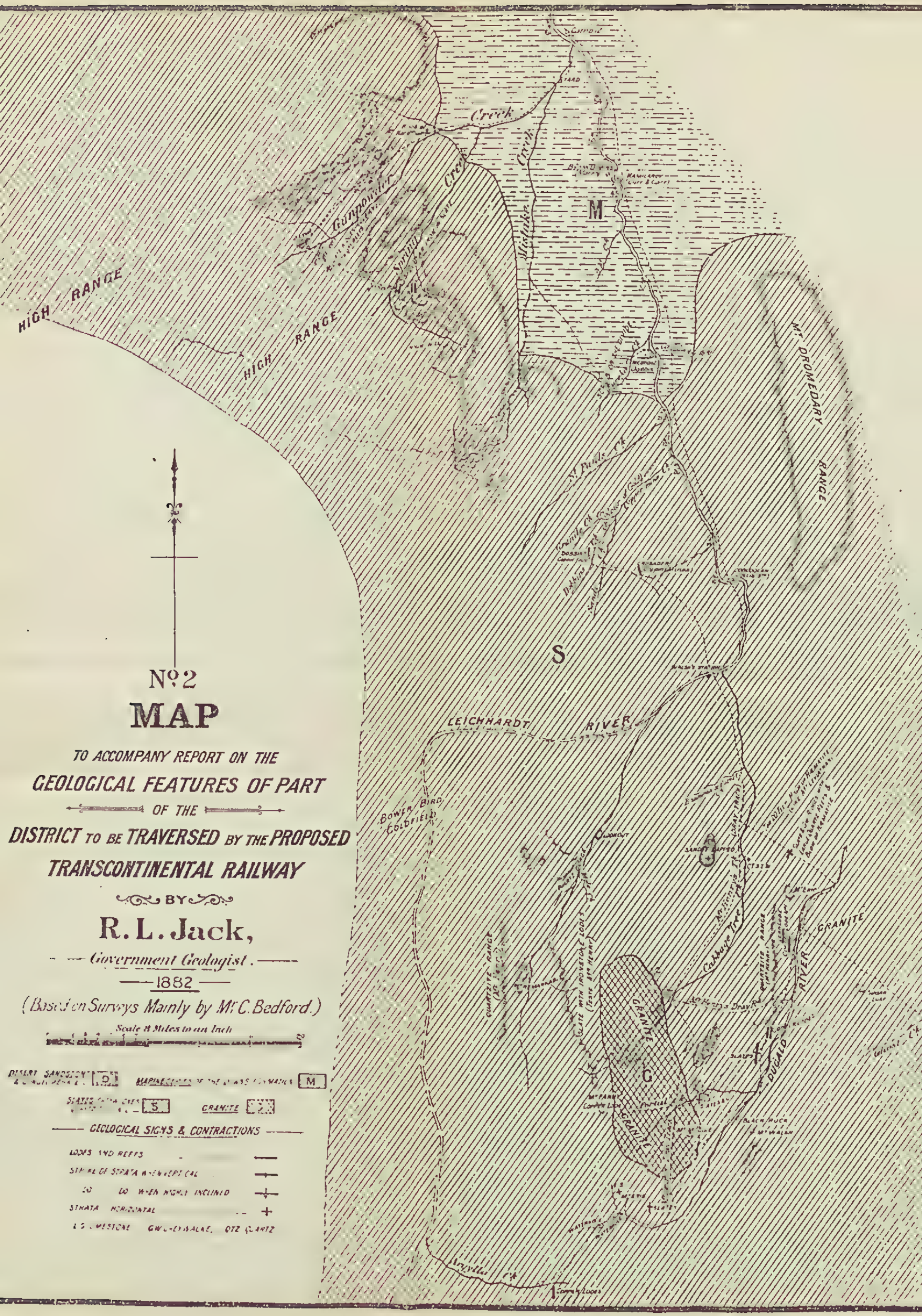
HIGH RANGE
HIGH RANGE
HIGH RANGE
Gunpowder Creek
Spring Creek
Westlake Creek
Creek
M
Mt. DROMEDARY RANGE
S
LEICHHARDT RIVER
BOWEN BIRD GOLDFIELD
QUARTZITE RANGE
SLATE (TESTE ARCHAEOCYATHUS)
Cabbage Tree
GRANITE
RIVER
DUGALD
GRANITE
G
GRANITE
Mt PARNELL
Copper Lode
Mt PARNELL
Copper Lode
Mt Purdie Ck
Dobbins Ck
Sandy
Argyle Ck
Comb's Lode
SANDY SPRINGS
Mt Henry
Mt Henry
Mt Henry

Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 11.

REPORT

ON THE

GEOLOGICAL FEATURES OF THE COUNTRY BETWEEN WARREN AND MOUNT LION, IN THE ROCKHAMPTON DISTRICT;

WITH A PLAN AND SECTION,

BY

B. DUNSTAN, F.G.S.,
Assistant Government Geologist.

BRISBANE:
BY AUTHORITY: EDMUND GREGORY, GOVERNMENT PRINTER, WILLIAM STREET.

1900.

LETTER OF TRANSMITTAL.

To the Honourable the Secretary for Mines.

Geological Survey Office,

Brisbane, 1st March, 1900.

Sir,—

I have the honour to forward herewith Report on the Geological Features of the country between Warren and Mount Lion, in the Rockhampton District, with explanatory Plan and Section, and to suggest that the Report be printed in Bulletin form.

I have, &c.,

WILLIAM H. RANDS,

Government Geologist.

REPORT ON THE GEOLOGICAL FEATURES OF THE COUNTRY BETWEEN WARREN AND MOUNT LION, IN THE ROCKHAMPTON DISTRICT.

Mount Lion is located about twelve miles in a westerly direction from Rockhampton, and Warren is a railway station near Stanwell, and seventeen miles south-west from Rockhampton. The country between these two places has been examined with the special object of determining what relation a limestone belt bears to the other sedimentary rocks in the vicinity.

The limestones contain a number of corals which previously had only been known to occur in Queensland in formations which are classed as Middle Devonian, and the task was to determine whether they were unconformable with and older than the "Gympie" strata above them, or whether they were sufficiently defined and conformable with the Gympie rocks to be regarded as a lower portion of that formation.

During a previous cursory examination while engaged working out the geological features of the Stanwell Coal Measures, the report of which has since been published,* the writer discovered a number of new fossils in this limestone. The recent examination has been carried out with more detail, and has satisfactorily cleared up all doubts with regard to their position. It has not only borne out what was expressed in that Report with regard to the relation of the limestones to the overlying rocks,† but additional information was obtained showing the sedimentary rocks below the limestones to contain marine fossil remains typical of the strata lying *above* the limestones.

The accompanying Map shows the boundaries of the geological formations, while the Section shows the inclination of the sedimentary rocks and other features in connection with the intrusion of several dyke rocks.

The oldest sedimentary rocks represented are sandstones, containing *Fenestella* with abundance of marine shells, and they occur around the southern flanks of Mount Misery and Mount Lion. The beds are inclined generally at an angle of 40 degrees, but the dip varies from 30 degrees to 60 degrees, and they rest on the felsite masses of which these two mountains are almost entirely composed. Where the sedimentary and the igneous rocks are in contact metamorphic action has changed the sandstones to quartzites, but this alteration is only local. As quartzites are often found having no apparent connection with intrusive or other igneous rocks, their occurrence here was at first not taken to be indicative of their alteration by the felsites. Isolated from the main mass felsite bosses crop out above the sandstones, but quite possibly they might have been worn surfaces around which the sedimentary rocks were deposited.

* The Mesozoic Coal Measures of Stanwell and Associated Formations. By Authority: Brisbane, 1898.

† *Ibid.*, p. 18, par. 2.

On the marine sandstones were laid the beds comprised in the coralline limestone belt, all the fossil remains of which, or species closely allied to them, are represented in the Burdekin (Middle Devonian) Beds. Taken by themselves there would be little hesitation in allowing the limestones to be considered older than "Gympie," even with the marine sandstones lying above them, as the conformity between the limestones and the sandstones might be only an apparent one, but with the marine sandstones also below the limestones it would be difficult to believe that they are not a portion of the same Formation.

Much of the limestone is oolitic, a result of concretionary accumulations around minute particles of shell and other material of organic origin. In some places the limestones are silicified, and the calcareous oolite is partly changed to a siliceous oolite, but retaining all the original concretionary structure. The corals also are occasionally well preserved in the same manner, and polished surfaces of specimens of the rock containing them when etched with acetic or weak hydrochloric acid show in beautiful relief the white siliceous lace structure of the coral sections on the dark limestone.

Immediately above and interbedded with the limestones are small bands of a granular calcareous rock, more or less ferruginous and clayey. It is probably an altered volcanic tuff that has been deposited on the coral reefs and so caused the destruction of the coral-building animals then in existence.

From observations made in other places to the south-east of Mount Lion, where similar beds of limestone occur, it is probable the belt is irregular in thickness and extent, partaking of the character of recent coral reefs. Mr. Rands, during 1891, made a preliminary survey of the country to the south and south-east of Mount Lion, and examined several of these limestone outcrops, and he inferred also from his mapping of them that they were conformable. They have been shown on the Map accompanying the Report on the Stanwell Coal Measures, previously referred to. The outcrops were only traced sufficiently far to make sure of their relation to the adjacent beds.

Above the limestones are irregular deposits of conglomerates, and above the conglomerates there is a great thickness of shales and sandstones carrying a variety of marine fossils common to the "Gympie" Formation. The sandstones are followed and the series completed by another large deposit of conglomerates.

The marine beds attain a total observed thickness of over 8,000 feet, but as the sandstones to the north-east of the limestone belt for a distance of two miles are to be seen in juxtaposition with the felsites, the actual thickness might be greater than this. The sandstones to the north-east conform with the general dip of the marine strata, but the data obtained were insufficient and too disconnected to base a calculation upon.

In estimating the thickness, the line of section shown on the plan has not been followed. The Section has a more southerly direction than the general direction of the dip of the beds, so a line was followed more north-easterly and south-westerly.

The chronological break between the ending of the marine deposition and the beginning of the freshwater formation called the "Upper Bowen" next succeeding is represented by a blank, and there is no evidence other than by comparison of similar formations in other places to show that a severe break at all exists between them. The two formations are apparently conformable, and not only have the same inclination, but the variations in the strike of one are repeated in the other.

The freshwater beds resting on the marine beds are made up for the most part of blue shales and greenish felspathic sandstones, and have an estimated thickness of 4,000 feet. The fossil fern *Glossopteris* is found in abundance in many of the exposed sections along the sides of the ravines at the head of Dinner Creek, but so far no other leaf impressions have been discovered.

The connection of the marine with the freshwater beds exposed further to the south along the line of section has not been settled satisfactorily, as their junction at this spot is obscured, but further explorations to the north-west might reveal what their relations are to one another. The most reasonable theory to account for the stratigraphical position they now occupy is that the rocks have been faulted —although the same results possibly might have been brought about by other means. If the freshwater beds were doubled up with the marine beds to produce a reversed fold, this would account for the presence of the marine sandstones and conglomerates at the southern end of the section, but there is an absence of any alteration in the freshwater shales and sandstones such as would result from a movement of this kind.

Again, it might be thought that the freshwater beds were laid down unconformably in a trough of the marine beds; but this also is an objectionable idea. The dip and strike of the beds of the two formations conform so closely that the agency which changed the marine beds from their originally horizontal position also changed at the same time the position of the freshwater beds.

Assuming, then, that the beds have been faulted, there are two places where such a movement could have taken place. At the head of Sawpit Creek the marine sandstones there might have been faulted from the marine sandstones about two miles away from them in a north-easterly direction, and on the opposite side of the freshwater beds. To effect this the fault would require a throw of about 10,000 feet. At Stewart's Creek a fault might have occurred, and the throw would require to be just as great; but this necessitates assuming the freshwater beds to be covered by the marine sandstone to the south of them, and to have these included as a marine series in one of the "Bowen" Formations. The marine beds do not agree from a palæontological point of view with other marine beds known to occur in some of the "Bowen" Formations, but they resemble very closely those found above and below the limestone belt at the other end of the Section near Mount Lion. That a dislocation of the rocks has probably taken place receives confirmation from the presence of the felsitic masses west of the line of section (not shown on the Map) which the beds come in contact with, and which might have produced changes in the vicinity, as the felsites at Mount Lion and Mount Misery have produced changes in that direction, as will be seen further on.

The marine beds here are also close to the line of the Stanwell Fault, which separates the Mesozoic Coal Measures from the "Gympie" Rocks,* so that the beds all around evidently have been subjected to depression while this comparatively small area of conglomerates have remained unchanged. It will be seen, when considering the intrusions of igneous rocks amongst the conglomerates, that the intrusions have consolidated this area to a greater extent than they have in other localities, and that in consequence the beds have not been depressed with the other members of the group.

With regard to the total thickness of the sedimentary rocks, if the fault takes place as assumed at Stewart's Creek, and the marine beds in consequence rest upon the freshwater beds, the thickness, taking the general angle of the dip to be 40 degrees from the horizontal, would be about 14,500 feet. In any case, a total thickness of 12,000 feet is revealed from the section, and this is measured from the outcrops near Lion Creek to the outcrops at the head of Sawpit Creek.

The Mesozoic Coal Measures, the Tertiary flows of basalt, and the deposits of recent alluvium do not call for special mention, but attention might be drawn to a small area of diorite in Selection 16v, which has been represented as Desert Sandstone on the Map accompanying the Stanwell report through an error when reproducing the map of the field-work. No Desert Sandstone is to be seen over the district examined, although on one side of Mount Lion there are fragments of a sandstone about whose age and origin there is a doubt.

Reference has been made to the acidic rocks of Mount Lion and Mount Misery. These felsites, together with other basic and intermediate dyke rocks, commonly occur all through the marine beds. In examining Mount Lion and the neighbourhood the felsite masses there did not show evidence of breaking into the sedimentary rocks, but subsequently they were discovered in several places penetrating the marine conglomerates, particularly at the head of Dinner Creek, where conspicuous vertical dykes have burst through the rocks in a north and south direction. None of the felsite dykes have been found to penetrate the freshwater beds, but it would be rather premature at the present state of our knowledge of the surrounding country to state that they do not penetrate them at all.

The basic and intermediate rocks include diorite, andesites, and dolerites, and are found intruding both the marine and the freshwater beds. Sheets of dolerite in the coralline limestone have forced their way along the bedding planes, while in other places the dolerite breaks across them, in both cases without producing a marked change where contact is made. To the east of the line of section, and further to the south-east of the limestones than the Map shows, a section is exposed, showing a number of dykes traversing the bedding planes of the sedimentary rocks, and having the following order:—

* *Loc. cit.* See map and fig. 7, p. 15.

Diorites and andesites, both porphyritic in some instances, occur in the highly metamorphosed conglomerates of Stewart's Creek, but whether they are the agency which has so altered the conglomerates, or whether the alteration has been produced generally by the felsite mass further to the west, remains to be seen.

The dyke intrusions in the conglomerates at Stewart's Creek are difficult to understand. The andesites undoubtedly penetrate the conglomerates, and therefore must be younger than them, but, as the conglomerates are in part made up of rounded pebbles of this rock not to be distinguished from those of the dykes, the andesites must be of two epochs, the one older, the other younger, than the conglomerates. As we assume the conglomerates to be of "Gympie" Formation, the older andesite therefore would probably correspond to that age, while the younger, which also penetrates the freshwater beds, would be of "Bowen" age.

Although there are no felsites associated with the younger andesites penetrating the conglomerates, there are felsite pebbles with the andesite pebbles in the conglomerates, producing a further complication by showing that the felsites must have been in existence both before and after the "Gympie" rocks were formed.

On Selection No. 1785 a dolerite is shown, but the Mesozoic Rocks have probably formed around it and so would be of younger age.

The pebbles of the "Gympie" conglomerates at Stewart's Creek also contain hornstone, jasper, and quartz, and the Mesozoic conglomerates in the vicinity are made up of pebbles which when broken show a fine pebbly structure somewhat metamorphosed, but also containing andesite, hornstone, jasper, and other material, so that the metamorphism of the "Gympie" Rocks is undoubtedly Pre-Mesozoic.

A recent deposit at Stewart's Creek is made up partly of material denuded from the original intrusive rocks, partly from the old conglomerates, and partly from the Gympie pebbles of the Mesozoic Beds.

In order to thoroughly understand the relation of the igneous to the sedimentary rocks at Stewart's Creek, and thereby obtain a key to much that now remains a mystery; a petrological study of the andesites, dolerites, felsites, and the altered conglomerates would be necessary. There are no difficulties in the way of examining them in the field, as the rocks are well exposed on the sides of very steep ridges, have suffered very little from decomposition, and the locality is easily reached from the Stanwell Railway Station.

SUMMARY.

Summarising the above, and omitting minor details, we have the felsites of Mount Lion as the oldest rocks represented along the Section, on which, as a marine formation (Gympie), were deposited sandstones, limestones, shales, and conglomerates. During the accumulation of this material, the felsites were gradually being elevated, and sending dykes of felsite into the marine beds, the elevations being such that the marine deposits were being replaced by estuarine or lacustrine deposits (Bowen). Between this and the next succeeding sedimentary formation a break exists, and for a time the deposition of sediment is discontinued, during which the freshwater and marine beds were intruded by basic and other igneous rocks, and the surfaces

of which were denuded and worn away into hollows. In these hollows another series of freshwater beds (Mesozoic) were formed, and these again were hollowed out in places by water action, and filled partly by molten lava (Tertiary). In this basaltic lava channels have been cut through which flow the streams of the present day.

This fairly agrees with the classification adopted in connection with the formations around Stanwell, and shown in the Report* previously referred to, but the additional information shows that the intrusion of diorite, andesite, &c., must be placed on a higher horizon than there shown, to penetrate the Bowen formation as well as the Gympie. Further developments might indicate these dyke rocks to be still younger.

CLASSIFICATIONS OF FORMATIONS.

Stanwell, Mount Lion, and Warren.

Cainozoic	Recent	Alluvium
	Tertiary	Basalt flows
Mesozoic	Upper Cretaceous	Desert Sandstone
	?	Flows of Trachyte and Rhyolite
	Upper Trias-Jura	Coal Measures
?	... ...	Intrusions of Andesite, Dolerite, &c.
Palæozoic	Upper Permo-Carboniferous	? Upper Bowen Formation
	?	Intrusions of Felsite
	Lower Permo-Carboniferous	Gympie Formation
	... ...	Granite, Felsite.

BENJAMIN DUNSTAN,

Assistant Government Geologist.

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* *Loc. cit.* Fig. 3, p. 9.

GEOLOGICAL MAP

shewing

formations between

WARREN & Mt LION

(NEAR STANWELL)

with special reference to the Coralline Limestone Belt of Lion Ck

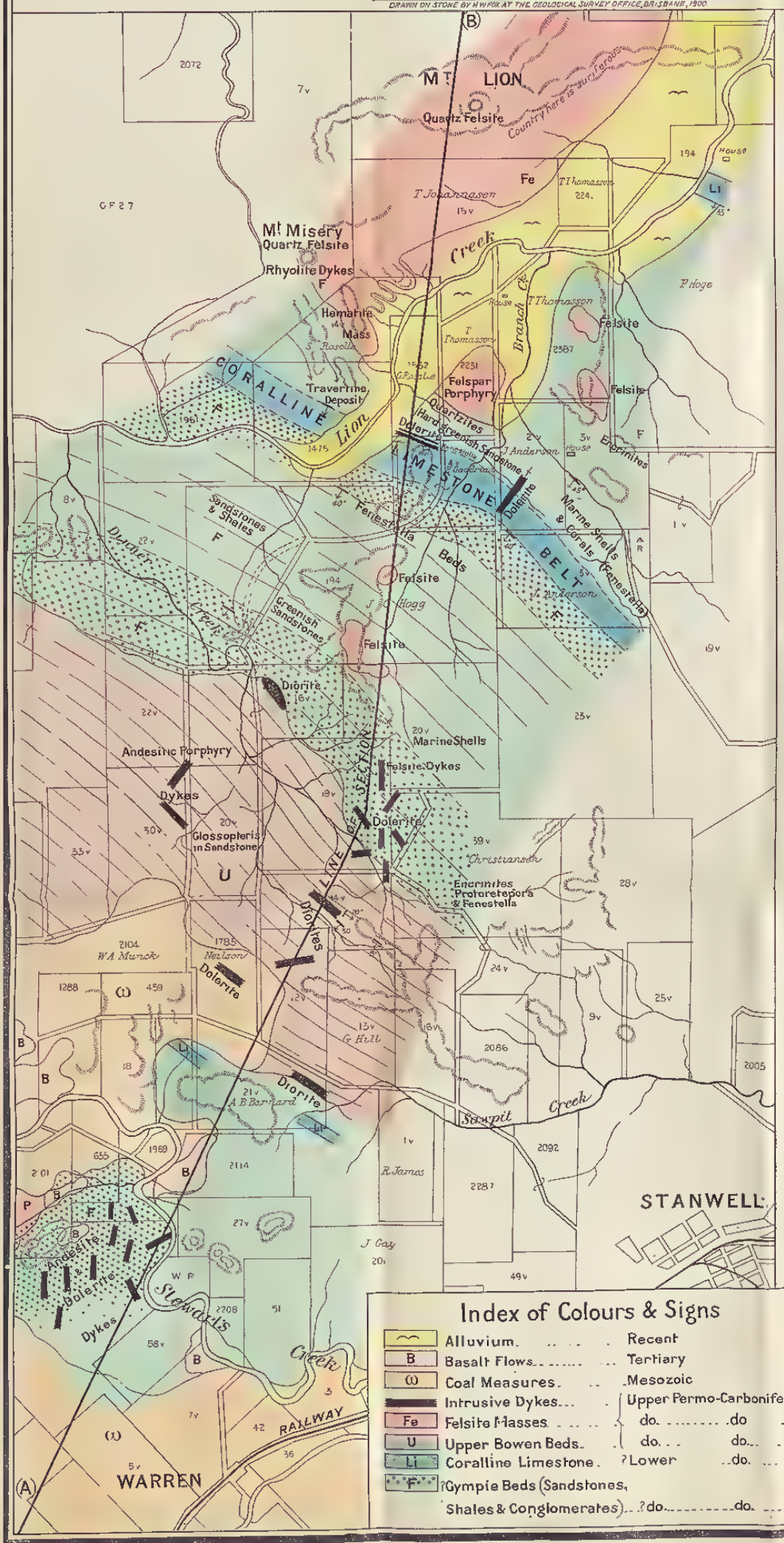
BY

B. DUNSTAN F.G.S.
Assistant Government Geologist

1900

Scale 40 Chains to an Inch

DRAWN ON STONE BY H.W.FOX AT THE GEOLOGICAL SURVEY OFFICE, BRISBANE, 1900.



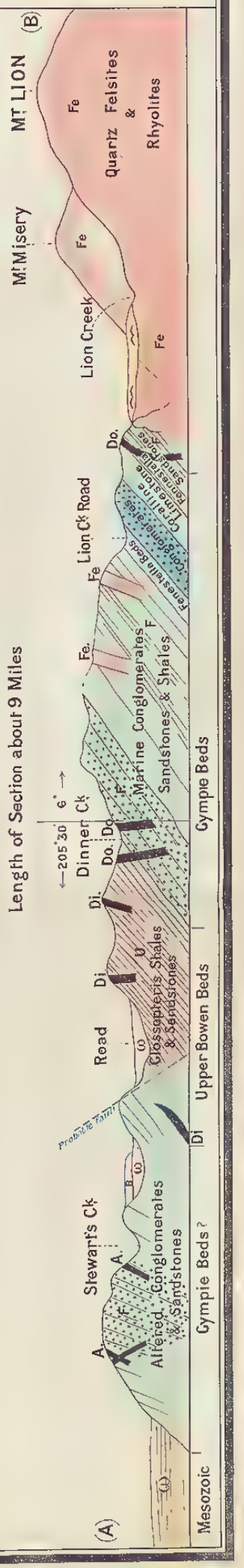
Index of Colours & Signs

	Alluvium	Recent
B	Basalt Flows	Tertiary
ω	Coal Measures	Mesozoic
	Intrusive Dykes	Upper Permo-Carboniferous
Fe	Felsite Masses	do. do.
U	Upper Bowen Beds	do. do.
Li	Coralline Limestone	? Lower do.
F	? Gympie Beds (Sandstones, Shales & Conglomerates)	? do. do.

SECTION ALONG (A)(B)

Between Warren and Mount Lion

Length of Section about 9 Miles



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DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 12.

CORALS FROM THE CORAL LIMESTONE OF LION CREEK, STANWELL, NEAR ROCKHAMPTON,

By R. ETHERIDGE, Junr.,
Curator of the Australian Museum, Sydney;

AND

OOLITIC LIMESTONES FROM LION CREEK, STANWELL, NEAR ROCKHAMPTON,

By G. W. CARD, A.R.S.M.,
Mineralogist to the Geological Survey of New South Wales.

NATIONAL MUSEUM MELBOURNE

BRISBANE:
BY AUTHORITY: EDMUND GREGORY, GOVERNMENT PRINTER, WILLIAM STREET

1900

LETTER OF TRANSMITTAL.

To the Honourable The Minister for Mines.

Geological Survey Office,

Brisbane, 13th August, 1900.

Sir,—

I have the honour to enclose the following papers, and to recommend that they be printed in pamphlet form as Bulletin No. 12:—"Corals from the Coral Limestone of Lion Creek, Stanwell, near Rockhampton," by R. Etheridge, Junr., Curator of the Australian Museum, Sydney, and "Oolitic Limestones from Lion Creek, Stanwell, near Rockhampton," by G. W. Card, A.R.S.M., Mineralogist to the Geological Survey of New South Wales, Sydney.

I have, &c.,

WILLIAM H. RANDS,

Government Geologist.

The corals submitted to me by Mr. Jack, supplemented by others forwarded by Mr. Dunstan, have enabled me to recognise the following genera as occurring in the Lion Creek Limestone—namely, *Syringopora*, *Michelinia*, *Stenopora*, *Fistulipora* or *Hexagonella*, *Koninckophyllum*, and three very interesting species that for the present must be provisionally referred to the Carboniferous genus *Lithostrotion*.

II.—DESCRIPTION OF THE SPECIES.

Genus Syringopora, *Goldfuss*, 1826.

(Petrefacta Germaniæ, I., p. 75.)

Syringopora syrinx, *sp. nov.*

(Pl. I., figs. 6-9; Pl. II., fig. 11.)

Sp. Char.—Corallum large, fasciculate. Corallites erect and contiguous, frequently parallel, or sometimes slightly flexuous; average diameter, 2 m.m.; walls moderately wide, and very much thickened by secondary deposit; so much so as to leave only very narrow visceral tubes; the latter simple and of uniform width in a given corallite. Connecting processes apparently both irregular and infrequent, hollow and devoid of endothecal tissue, thickened like the corallites; the latter often come in partial contact, and coalesce by their walls. Septa numerous, long, and spiniform, very unequally developed as to number in a cycle; but, when perfect, twelve in number, projecting well into the visceral tubes, and often traceable through the secondary thickening. Tabulæ distant, unthickened, horizontal, oblique, or somewhat concave, but infundibuliform diaphragms not observed. Increase by lateral gemmation, the new corallites branching either at an acute angle or widely geniculate.

Obs.—A very remarkable form of *Syringopora* in consequence of the great thickness of the walls of the corallites in comparison with their diameter. The walls proper are composed of brown sclerenchyma, lined by light-grey laminated stereoplasma to such an extent as to leave but the narrowest possible visceral tube throughout each corallite. The septal spines, which are long, can be traced through this to the walls proper, leaving the sharp apices projecting into the visceral tubes (Pl. I., fig. 7).

In only a very few instances have I been successful in detecting transverse connecting processes, the union of corallites taking place by a partial coalescence of their walls in bundles of two, three, or four. Whether or no these points of union are each perforated by an opening assuming the functions of a mural pore, I am quite unable to say; but the late Professor H. A. Nicholson, speaking of mural pores in this genus, says: "Nor have I much doubt that at any points in the corallum of a *Syringopora* at which the corallites come into actual contact, openings in the wall, placing the body-cavities of the polypes in direct communication, will be found to exist, though I have as yet had no opportunity of verifying this conjecture.* Endothecal tissue is remarkable for its paucity, both in the visceral tubes and in the few connecting processes that have come under observation. I have detected no infundibuliform tabulæ proper, producing the

* Tab. Corals Pal. Period, 1879, p. 214.

"onion-like" appearance so characteristic of the species in general of this genus, although in one of the cross-sections there occur a few semicircular cut edges of tabulæ (Pl. I., fig. 9), but these may be only the severed concave tabulæ which exist in this form in conjunction with horizontal and oblique. On the tabulæ of *Syringopora*, Nicholson remarked:* "Some forms of *Syringopora* are stated to possess horizontal tabulæ, but the true structure and position of these will require to be more fully worked out before this can be finally admitted." Horizontal tabulæ are undeniably present in *S. syrinx*. The septa seem to be very irregularly developed in a given cycle, although numerous on the whole. As a rule, a perfect septum will be noticeable, between two imperfectly developed, the latter merely represented by a bulging inwards of the stereoplasmic thickening (Pl. I., fig. 9).

The visceral tubes are filled either with clear calcite with cleavage, or the latter disseminated throughout matrix.

Syringopora syrinx in the coalescence of its corallites, and the replacement of funnel-shaped or infundibuliform tabulæ by more or less horizontal ones, exhibits a departure towards the genus *Cannopora*, J. Hall,† but I have not been able to detect the mural pores said to be present in *Cannopora*, at the points of coalescence of its corallites. It is quite distinct from the *Syringoporæ* of the Tamworth Limestone, New South Wales, *S. auloporoides*, de Kon., and *S. Porteri*, mihi, nor does it possess anything like the regularity of form and growth of *S. novæcambrensis*, Mihi. In external appearance it approaches *S. ramulosa*, Goldf., but not in internal anatomy. A similar internal thickening of the corallite wall is figured by Nicholson in *S. geniculata*, Phill., but in this case the septa do not protrude through the secondary thickening.

Genus Michelinia, *De Koninck*, 1842.

(Descrip. Anim. Foss. Terr. Carb. Belgique, p. 29.)

Obs.—In sectioning a piece of limestone a coral was revealed presenting some of the characters of *Michelinia*. It appears to have formed a depressed hemispherical corallum of small size, about 1 inch by 1½ inches, and of somewhat irregular growth. The prismatic corallites are much crowded together, variable in diameter between the extremes of two and four millimetres, with the walls thickened to some extent, although not greatly so. Mural pores are very sparsely developed, but septa were present as vertical rows of tubercles, for cut ends are to be seen in some of the visceral chambers. The tabulæ are very numerous, and anastomose freely, so that the usual vesicular condition of the tabulæ seen in *Michelinia* is here present; a few are horizontal.

The general appearance presented by the sections so thoroughly coincides with that of *Michelinia*, little doubt is left in my own mind that we may now regard this genus as added to our Permo-Carboniferous list. It certainly occurs at Somerton, New South Wales, in the Lower Carboniferous, a good and well preserved example from that place being in the New South Wales Geological Survey Collection.

* Tab. Corals Pal. Period, 1879, p. 211.

† Rominger, Geol. Survey Michigan. Lower Peninsula, 1873-76, iii., Pt. 2, 1876 p. 86.

For obvious reasons a specific name is not proposed, pending an examination of the New South Wales form, which appears to be of larger growth than that from Queensland.

Genus Fistulipora* or Hexagonella.†

Obs.—Another piece of the Stanwell Oolitic Limestone is seamed at irregular intervals by variously-sized laminar fragments of a coral not otherwise seen. At only one spot on the exterior of this hand specimen is the fossil visible, and then much weathered.

The coral seems to be in depressed convex masses, of irregular outline and small size, composed of several superimposed layers, or it may even be a crumpled ramose mass; it is very difficult to decide in the present condition of the specimen. The weathered surface, although very limited in extent, is more or less flattened, and displays a number of open tube mouths, with the margins sometimes thickened and rim-like, from two to three occupying the space of one millimetre.

The thin sections, prepared for the microscope, in consequence of alteration that has gone on during fossilisation, are not as satisfactory as they might be, but in a transverse section the larger tubes or autopores are oval, or rather pyriform, and do not exhibit pseudoseptal folds. The mesopores, in this view, although indistinct, are irregularly distributed between the autopores, one to several existing between contiguous tubes. In longitudinal sections, the anatomy is much plainer; for instance, the tabulation of the autopores is visible, the tabulæ being complete, horizontal to a little concave, and inequidistant from one another. In this view, the mesopores are seen to be perfectly developed, the plentiful tabulæ coalescing to form a tissue of very small lenticular vesicles, 0·2-0·25 mm. in transverse diameter; there are from one to six rows of vesicles between contiguous autopores. No indication has been observed of pseudoseptal spines in the autopores, nor any trace, on the small portion of exterior surface visible, of maculæ, acanthopores, nor polygonal spaces bounded by ridges.

In several of the colonies a line of transverse division seems to be visible in longitudinal section, either central, or excentric, that in some respects presents the appearance of a divisional lamina. In no instance is it absolutely clear, but as the corallites do not bend or diverge outwards from these lines, but maintain a common direction, it is possible that they represent merely growth stages.

In the absence of further details, it seems to me that these colonies are referable either to *Fistulipora* or *Hexagonella*. If a median lamina does not exist, the evidence then points to the former, although neither the peculiar trifoliate outline of the autopores nor pseudosepta have been observed. As against *Hexagonella*, there is no trace on the limited exterior surface visible of ridges dividing it into hexagonal or polygonal spaces. This is, however, of minor importance, as the ridges are said to often wear off and become almost imperceptible. To whichever of these genera the colonies in question belong,

* *Fistulipora*, McCoy, 1849 (Ann. Mag. Nat. Hist., 1849, iii. (2), p. 130). Emend. Nicholson and Foord (*Ibid.*, 1885, xvi. (5), p. 496).

† *Hexagonella*, Waagen and Wentzel, 1886 (Pal. Indica, Ser. xiii., I., Pt. 6, 1886 p. 911).

their occurrence is of much value, because, so far as I remember, *Fistulipora* has not yet been recognised as an Australian genus, and *Hexagonella* is not at present known to occur in Eastern Australia.

Genus Stenopora, *Lonsdale*, 1844.

(Darwin's Geol. Obs. Volc. Islands, p. 161, note.)

Stenopora Leichhardtii, *Nich. and Eth. fil.*

(Pl. I., figs. 10–12.)

Stenopora Leichhardtii, Nicholson and Eth. fil., Ann. and Mag. Nat. Hist., 1886, xvii. (5), p. 179, t. 3, f. 7 and 8.

Stenopora Leichhardtii, Eth. fil., Geol. and Pal. Queensland, &c., 1892, p. 204, t. 6, f. 9 and 10, t. 7, f. 2.

Obs.—In the same piece of oolitic limestone, with the fossil last described, occur small lobate masses of *Stenopora*, probably portions of a dendroid corallum. Both transverse and longitudinal views of the latter are exhibited in the same section. The transverse is exceedingly interesting, for it shows the calices of *S. Leichhardtii*, presuming my determination to be correct, under an aspect not hitherto described.

This species was separated by my late friend and myself from the other Queensland forms of the genus in consequence of the great abundance of the acanthopores and their large size. The present specimen is similarly provided. The corallites have an average diameter of 0·23 to 0·35 mm. when unthickened, and exhibit the usual polygonal outline more or less throughout the section (Pl. I., fig. 10). The periodical thickenings of the walls, visible in a longitudinal view, are fusiform and not very long, but tabulæ appear to be very sparsely developed; when present, however, they are somewhat concave.

In one portion of the transverse section the walls of the corallites are greatly thickened, although the polygonal outline is more or less retained. Each visceral chamber is surrounded by a circlet of unthickened acanthopores, amounting in some instances to as many as eighteen, with those at the angles of junction of corallites slightly larger (Pl. I., fig. 11). In another part of the same section the walls are decidedly less thickened, but with a corresponding increase in the size of some of the acanthopores, or a lessening in their number when all are enlarged, and a similar increase takes place in the thickness of their walls. To such an extent is this often carried that the acanthopores project into the visceral chambers, rendering the outline of the latter of a most irregular form (Pl. I., fig. 12). In each case the acanthopores are round or oval with a dark centre. In longitudinal section they are here and there visible as dark lines running in the substance of the walls. In our original description of *S. Leichhardtii*, we remarked that the walls of the acanthopores were not specially or only slightly thickened, but here the converse is the case; their concentrically laminated structure is also very apparent.

In a third portion of the section, the corallites are thin-walled simply, distinctly polygonal, with occasional, but always distant, thin-walled acanthopores (Pl. I., fig. 10).

On the whole these sections correspond remarkably well with that of *S. Leichhardtii* as described by Professor Alleyne Nicholson and myself, and I see no reason to doubt the presence of this species in the Stanwell Limestone.

Genus Lithostrotion (*Lhuid*), *M. Edwards and Haime*, 1851.

Lithostrotion, M. Edw. and Haime, Polyp. Foss. Terr. Pal., 1851, p. 432.

Lithostrotion, M. Edw. and Haime, Mon. Brit. Foss. Corals, pt. 3, 1852, p. 190.

Lithostrotion, Thomson and Nicholson, Ann. and Mag. Nat. Hist., 1876, xvii. (4), p. 290.

Lithostrotion, Thomson, Corals Carb. System Scotland, 1883, p. 102.

Obs.—Amongst the corals from the Stanwell Limestone are three exceedingly interesting and somewhat anomalous species. It is proposed to call these *Lithostrotion? columnare*, *L.? arundineum*, and *L.? stanvellensis*, but regarding the reference to the genus as provisional only.

The corallum is either in the form of compound masses (*L.? columnare*), the corallites firmly adherent to one another, or in fasciculate groups (*L.? arundineum* and *L.? stanvellensis.*). The corallites are long and straight in the two first-mentioned species, but somewhat irregular in the third and shorter form. In *L.? columnare* the corallites are prismatic and chiefly hexagonal in outline, with exsert margins in the weathered condition, and a general average diameter of 10 millimetres. From the edge of each tube the surface slopes inwards for about half the tube diameter, and then rises in a more or less convex intra-mural ring, again subsiding within to the centre of the calice, where a moderately prominent columella is usually visible. The condition of the actual exterior of a corallum is unknown to me, nor do any of the specimens exhibit the method of attachment of the colonies; in all probability the outline was either round or oval.

In both *L.? arundineum* and *L.? stanvellensis* the corallites are round, or if pressed together an oval outline is assumed, more so in the former than the latter. The diameter of the corallites of *L.? arundineum* varies from 4 to 5 millimetres, and in *L.? stanvellensis* 8 to 10 millimetres. In the first the greatest longitudinal measurement obtained was 8 inches. In both, the corallites are surrounded by an epitheca, more or less well developed, and accretion ridges are present also.

On a weathered surface of *L.? columnare* the corallites have every appearance of being bounded by well-marked walls, and it is only on polished surfaces here and there, or in thin sections prepared for the microscope, that the real nature of the divisional walls can be detected; these boundaries, as often as not, are then seen to be vesicular. In some corallites, or at times only in one part of a corallite, a distinct wall of separation is visible (Pl. II., fig. 2); at others, a line of demarcation presenting the appearance of a broken-up or sub-vesicular wall is all that presents itself (Pl. I., fig. 1). Of the three conditions, a simple vesicular structure separating the corallites

one from the other is the most frequent, the vesicles in question presenting the appearance of a secondary infilling (Pl. I., fig. 1). In both the other species the walls are by no means well marked, but are feeble.

In dealing with the internal anatomy I propose to describe that of *L.? columnare* somewhat fully, but that of *L.? arundineum* and *L.? stanvellensis* will be less so, as it will only be necessary to show how the structure of the two latter differs from that of the first-named.

In a transverse microscopic section of *L.? columnare* each corallite possesses a peripheral zone, which at times has a highly vesicular structure; at others it is less so, then presenting the appearance of a disjointed wall, or line of filled-in vesicles, but seldom a continuous and sharply defined wall. From this zone the septa proceed inwards, to the number of 40-48, primary and secondary. When the wall is compact, or composed of a line of filled-in vesicles, the septa proceed from it in the ordinary manner; but when presenting its most vesicular condition, the proximal ends of the septa are lost in this tissue, except that here and there the primaries pass through it, in a more or less zigzag manner, and become confluent with those of contiguous tubes, after the manner of *Phillipsastræa* (Pl. I., fig. 1).

The septa are all thickened; the primaries pass directly to the calicinal centre, but the secondaries are a little less than half the length of the former, and extend only to the distal edge of an inner mural investment, or wall. The primaries, on arriving at the centre of the calice in each corallite, all unite with a thick and highly pronounced columella, which is either round, oblong, subfusiform, or of an irregular shape; but, be this as it may, the combined columella and its septa presents the appearance of a central figure with a series of radiating processes or fingers (Pl. I., fig. 1; Pl. II., figs. 1 and 5).

This columella (Pl. II., fig. 3) forms a continuous rod extending the whole length of a corallite, from the bottom of a visceral chamber to the floor of the calice, and is either wholly dense or somewhat vesicular in the centre, the vesicles in this view being represented by interrupted patches of clear calcite. From the fact that the primary septa can at times be certainly traced within the substance of the columella, it would seem probable that this vertical plug had been formed by a stereoplasmic infilling between the distal ends of the septa, around an originally lamellar columella. This view is borne out by two other facts—(1) In a weathered specimen the septa are visible in the ordinary form of vertical lamellæ, proceeding directly to and joining a subfusiform or almost linear columella; and (2) that in some of my sections the primordial columella is visible as a simple transverse line in the substance of the present thickened mass.

Another very marked feature is the union of two or more primary septa in bundles immediately before reaching a columella. In this condition two is the ordinary number, but combinations of three and four have been observed (Pl. I., fig. 1). The primordial septa are not often preserved, but the lamellæ in their present condition are much thickened, and here and there present a curiously ragged or broken outline, and at times are irregular in their course, or somewhat tortuous; very frequently two, one from either side, in the longest diameter of a corallite, unite with the primordial lamina of the columella (Pl. II., fig. 5).

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The endothecal tissue occupying the interseptal loculi varies according to its position in the corallite (Pl. I., fig. 1). In the vesicular peripheral space transverse dissepiments proper can hardly be said to exist, but within this the interseptal loculi are occupied by true dissepiments, either in a line with one another or alternate in adjacent loculi, but distant from one another in the same loculus. Between these and the second zone of dissepiments the loculi are filled with clear calcite, but the latter consists of several cycles of well-marked dissepiments, commonly six, close together, rectangular, and continuous on the same line from loculus to loculus. At the distal edge of this zone is the inner-mural investment already spoken of. Between this and the columella the loculi are again devoid of dissepiments, or, if the latter be present, they are occasional only. These are the fundamental features in this coral, but variations in degree, of course, occur—one or other of the zones may predominate more than the others; the component dissepiments may be closer or more distant from one another, and so on.

In *L.* ? *arundineum* (Pl. II., fig. 6), the wall appears to be very thin, and there is no peripheral zone of vesicular tissue pure and simple. The septa to the number of forty, primary and secondary, and very constantly forty, proceed directly towards the columella, are fairly straight in their course, and but little thickened except at their immediate bases. Some of the primaries unite with the columella, in bundles of two or three, but others stop short of the centre; the secondaries are hardly equal to half the length of the primaries.

The columella is either round, subfusiform, or even oval, and by its union with the primary septa presents the same finger-like appearance as in *L.* ? *columnare*. The primordial columella is almost invariably visible as a thin styliform body, again not infrequently in direct communication with the two principal primary septa from opposite sides of a corallite, but these two septa are not otherwise differentiated from their fellows. I have said that some of the primary septa stop short of the columella, usually adjacent to one another, and when in this condition their distal ends unite to form a partial ring. The space between this and the columella is either filled with clear calcite, or finely divided matter, similar to the infilling of some of the dissepimental vesicles. As in *L.* ? *columnare*, the primordial septa are not often preserved, nor do any of the septa present the same ragged appearance as those of that species; similarly, no vesicular structure has been noticed in the columella.

The dissepiments in the interseptal loculi are far more regularly arranged than in *L.* ? *columnare*. They are at right angles to the septal laminæ, either alternate in contiguous loculi, or in a line with one another forming a cycle, with their convexities outwards. This dissepimental zone is of greater or less width, sometimes even extending comparatively close to the columella. This point is situated at from one-half to three-quarters the distance between the wall proper and the columella. A few cut edges of dissepiments may at times be seen within this in the interseptal loculi wherever the primary septa extend to the columella.

In *L.* ? *stanvellensis* (Pl. I., fig. 5) the much larger, shorter, and less regular corallum than in the last species is distinctive, but the characters of the wall, septa, and dissepiments are similar to those of

L.? *arundineum*, except that the wall is more pronounced, the septa thicker, and the primordial septa more frequently visible. The gathering of the septa into bundles is again present, although not with the same persistency as in the other two species, but the characters of the columella are quite in accord with those of *L.*? *arundineum*, even to the presence of the primordial style and its junction with the two principal primaries; there are sixty septa, but the secondaries are shorter than in *L.*? *arundineum*. In portions of some corallites there is the same definite ring, exterior to the columella, as in *L.*? *arundineum*.

The inner-mural investment is much less marked, in fact in some transverse sections of corallites it can hardly be traced.

In neither of the species is there any definite trace of a fossula.

When viewed in longitudinal section (Pl. II., figs. 3 and 4) the structure of *L.*? *columnare* varies according to that portion of the corallite traversed. In a section taken exactly through the centre of a corallite (Pl. II., fig. 3) the following facts are observable. At some points neighbouring corallites unite simply by means of vesicular tissue, in others there is the semblance of a wall, and again at times a compact definite wall is present, but even in the two latter instances followed by irregular vesicular tissue. This is succeeded by a zone of lenticular vesicles, variable in size, and with their convexities directed upwards and inwards, and bounded distally by the well-marked inner-mural investment. The columella is surrounded by other vesicles of a very irregular form, but if their upper surfaces are presented in any one direction more than another it is upwards and outwards; these may perhaps be denominated incomplete vesicular tabulæ, for some are more or less horizontal. Whatever their direction, the demarcation between them and the vesicles of the outer zone is very marked.

In the upper portion of a section of one particular corallite, the columella is seen as a solid body, but in the centre is broken up into component septa, and below reappears in the solid form (Pl. II., fig. 3). Whether this appearance really represents the structure of the columella, or whether it arises from the latter passing in and out of the plane of the section, and where passing out, the septa coming in, I am undecided, but, from the appearance already described in a weathered example, I am led to believe that the suggestion previously advanced—viz., the filling up of the loculi immediately around the columella—is the correct one. In an excentric section passing through the middle dissepimental zone, at right angles to the septa, the cut vertical edges of the latter are visible, and the interseptal loculi filled with irregular more or less horizontal dissepiments (Pl. II., fig. 4); on the other hand, if the section happens to cut the plane of the peripheral zone only, then a confused mass of vesicular tissue simply, is seen*.

In *L.*? *arundineum*, a longitudinal section (Pl. I., fig. 4) exactly through the centre, exposes the columella as a dense, compact, vertical rod, surrounded by vesicular tissue. The vesicles next the columella are dome or tent-shaped, with their convexities upwards and outwards, followed laterally by others of a very variable form, but, on the whole, having a resemblance to irregular and incomplete tabulæ. Separating this series from the peripheral zone is the inner-mural investment, but

less marked than in *L.? columnare*. The peripheral zone of vesicles is very narrow, seldom consisting of more than two rows, the convexities of the vesicles being inwards and upwards.

In the third species, *L.? stanvellensis* (Pl. II., fig. 8), the appearance of the columella is precisely similar to that in *L.? arundineum*, but the vesicular tissue of the central area of the former is not only more copious than in the latter, but also lacks the markedly dome or tent-shaped outline, and is, more strictly speaking, ordinary lenticular tissue, the convexity of the vesicles upwards and outwards, but always much larger than those forming the peripheral zone. This difference in the anatomy of the two species is very marked and distinctive. The peripheral zone is narrow, but wider than in *L.? arundineum*, the convexity of the vesicles being again upwards and inwards.

One of the most important features in all three corals is the strong line of demarcation between the vesicular zone bounded by the inner-mural investment, and that surrounding the columella, whether it be marked by an investment or by the varying aspect of the convex surfaces of the vesicles.

We may now with advantage consider the affinities of these corals. The anomalous structure of the intercorallite walls in *L.? columnare* may lead some to suggest that it arises from an error in observation, but I have submitted the sections to many careful examinations, and always with the same result. To guard against mistake, Mr. W. S. Dun has made an independent study of the species, and coincides in the conclusions I have arrived at.

The existence of the peripheral vesicular tissue indicates a departure towards *Pachyphyllum*, confirmed by the confluence of some of the primary septa of contiguous corallites, and in the projection of the septa towards the centre, but a columella does not exist in this genus. Again, *Chonaxis* possesses a peripheral mass of vesicular tissue around each corallite of very variable width, which here and there seems to almost merge into a wall, and a central mass, around which the septa stop short, consisting of arched tabulæ. Edwards and Haime speak of a lamellar columella in *Chonaxis*, but even with this the resemblance to the present species is only a general one.

A reference has already been made to a possible alliance with *Phillipsastræa* from the confluence of septa in contiguous corallites. The same may be said of the two primary septa that join the primordial columellarian style. Dr. R. Schäfer says of *Phillipsastræa radiata*, that "of the longer septa, two or more opposite ones meet and thus form in the calicular fossa a transverse ridge, which sometimes is joined by other septa.* The septa only meet and do not constitute a columella, but the line formed by the united septa traverses the whole corallite in transverse section. In the centre this line is often somewhat thicker, and in some cases is joined by others of the primary septa.† There is also a similar grouping of the septa to that seen in *L.? columnare*. The supposed columellarian tubercle of *Phillipsastræa* is thus described by Dr. C. Rominger:—"The longer lamellæ

* Geol. Mag. 1889, vi. (3), pp. 401, 403, f. 1-3.
† *Ibid*, p. 404.

[septa] unite in the centre, and form a pseudo-columellar, nodular protuberance, but do not connect into a continuous vertical axis."* In *P. Verneuilli*, "the centre of the calyx bottom is raised into a columellar knot, and in vertical sections of calcified specimens a central string of greater density can be observed, but it is not a solid axal column; in some specimens no indication of a columella is perceptible."† Now, there is no evidence in the Australian coral of a columellarian tubercle, but there is a continuous longitudinal styliform axis with which, I believe, the primary septa unite, accompanied by a subsequent deposition of secondary material between the distal ends of the septal lamellæ.

In the light of *L.? arundineum* and *L.? stanvellensis* other affinities of a very marked character present themselves. The genus *Lithostrotion*, typified by the species *L. basaltiforme*, Flem., sp.,‡ contains astræiform or fasciculate colonies of cylindrical corallites with well-developed primary septa, a more or less well-marked compact, styliform, fusiform, or laterally compressed columella, and complete and non-vesicular walls. With *Lithostrotion*, some writers, following Edwards and Haime, have united *Nematophyllum*, McCoy, *Stylaxis*, McCoy, and *Siphonodendron*, McCoy. This step may be correct for all that I am able to advance against it, situated as I am, but sufficient investigation certainly does not appear to have been directed towards the structure of the columella in the above forms, and its intimate relation to the primary septa—a much commoner feature in some species than most authors have grasped. In describing the relation of these organs one to the other, the language used has invariably been loose and indefinite, thus:—In its comprehensive and modern significance, *Lithostrotion* may be said to date from the publication of Edward's and Haime's 'Polypiers Fossiles,' and the third part of their 'British Fossil Corals.'§ In the first of these works they say "cloissons assez bien développées. . . . une columelle styliforme," that is all; in the second publication no special remarks are made, but in a previously published part of the same,‖ under the name of *Lithodendron*, they said—"*Columella* styliform, compact. *Septa* well developed, but not reaching to the columella." In describing *Nematophyllum* (vel *Nemaphyllum*), McCoy said:—"Having a straight, thin, flat, fillet-like, solid, or nearly solid axis, from which in the horizontal section, the fine, numerous radiating lamellæ [septa] are seen extending directly to the walls."¶ Of *Stylaxis*, he remarked—"The central axis is surrounded by radiating lamellæ [septa] extending from the walls."** Of *Siphonodendron*, McCoy states that it possesses a "small tube-like axis, surrounded usually by a few thin concentric lines . . . from these the vertical lamellæ radiate to the circumference."†† The descriptions of *Nematophyllum*, *Siphonodendron*, and *Stylaxis* were repeated in his large work on the 'British Palæozoic Fossils.' It will

* Geol. Survey, Michigan. Lower Peninsula, 1873-76, iii., Pt. 2, 1876, p. 128.
† *Ibid.*, p. 129.
‡ Edwards and Haime, Polyp. Foss. Terr. Pal., 1851, p. 432; Thomson and Nicholson, Ann. Mag. Nat. Hist., 1875, xvii. (4), p. 292.
§ Corals from the Permian Formation and the Mountain Limestone, 1852, p. 191.
‖ Introduction, 1851, p. lxxi.
¶ Ann. Mag. Nat. Hist., 1849, iii. (2), p. 15.
** *Ibid.*, p. 119.
†† *Ibid.*, p. 127.

be observed that from these remarks no criterion can be formed of the intimate relation of the septa and columella, if any, in either case, but in the diagramatic type figures given by this author, the two sets of organs are separate and distinct.

Lithostrotion, by the late Prof. L. G. de Koninck, is said to possess "cloisons nombreuses et assez bien développées . . . . une columelle centrale, styliforme."* Messrs. J. Thomson and Alleyne Nicholson, however, are more explicit, when remarking that the "septa extend from the inner surface of the wall to varying distances from the columella. A few of the primary septa sometimes actually reach the columella. . . . . The columella is always present in each corallite, and has the form of a flattened, laterally compressed, compact rod, which extends without interruption from the bottom of the visceral chamber to the floor of the calice."† In another publication, Mr. Thomson alone, after referring to the "great diversity of structural characters" in *Lithostrotion*, says that in some forms the "primary septa extend inwards to the columella, whilst in others they stop short of the centre."‡ He enumerates no less than six species (*L. ensifer*, *L. clavatica*, *L. Portlockii*, *L. aranea*, *L. Flemingii*, and *L. maccoyanum*), in which the primary septa either extend to or are *attached* to the columella, and, in some cases, after coalescing into groups. The best example, perhaps, is his own species, *L. clavatica*, in which the primary septa "extend into" the columella. At the same time it is worthy of remark that in the accepted type of the genus, *L. basaltiforme*, the primary septa "extend to near the centre of the calicular cavity" only.§

From the foregoing extracts, it will be seen that Messrs. Thomson and Nicholson are amongst the few who have given attention to this important subject, but particularly Mr. Thomson.

The corals first mentioned are amongst the astræiform species only; the structure of the fasciculate appears to have been less studied even. Mr. Thomson says that in *L. junceum* a few of the primary septa are "united with the minute columella," a fact I can confirm from specimens I have before me; as well as another fasciculate form of European *Lithostrotion*, in which the septa are grouped, and some connected with the columella.

McCoy's later illustrations although no reference is made to points of this nature in the text, seem to bear out the structures described by Mr. Thomson. Thus, in one of the figures of *L.* (*Stylaxis*) *Flemingii*, the artist appears to have represented a union between the primary septa and columella‖; the same again in *L.* (*Nematophyllum*) *arachnoideum*,¶ and in *L.* (*Nematophyllum*) *clisioides*;** and in one, *L.* (*Siphonodendron*) *irregulare*, there is not only an unmistakable junction of two of the primary septa in alignment with the columella, but grouping also,†† similar to that seen in the Queensland corals.

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* Nouv. Rech. Anim. Foss. Terr. Carb. Belgique, Pt. 1, p. 26.
† Ann. Mag. Nat. Hist., 1876, xvii. (4), p. 290.
‡ Corals Carb. Syst. Scotland, 1883, p. 103.
§ *Ibid.*, p. 104.
‖ Brit. Pal. Foss., Fas. 2, p. 185, t. 3A, f. 4*a*.
¶ *Ibid.*, t. 3A. f. 6*a*.
** *Ibid.*, t. 3B, f. 2*b*.
†† *Ibid.*, t. 3A, f. 5*a*.

Again, it is a remarkable fact that in at least two species of *Lithostrotion* a peripheral zone of vesicular tissue has been recorded; for Thomson describes its presence in *L. cyathophyllia*, *L. Portlockii*, and to some extent in *L. basaltiforme* also.* Even the occurrence of confluent septa in contiguous corallites may be inferred by Edwards and Haime remarking of *L. ensifer*, that "by the mode of coalescence of the corallites it bears some resemblance to the genus *Phillipsastræa*."†

It will be readily perceived that the all-important point in connection with the present investigation is—What is to be regarded as the precise limitation of the genus *Lithoštrotion?* Is it to be retained in the face of the "great diversity of structural characters," as at present constituted, or, is a subdivision of the species advisable and possible, based on this "diversity" of morphological structure? On the answers to these questions will depend the generic position of the three species now described. Far removed from types as I am, they are questions which must be left to abler hands than mine, for it is an investigation that would well repay anyone having access to McCoy's types in Cambridge, and Edwards and Haime's in Paris, and elsewhere. As an illustration I may simply remark that of five European species now before me, three possess an inner-mural investment; in four the primary septa unite with the columella; three have the septa grouped; and one exhibits a zone of peripheral vesicular tissue.

The history of *Lithostrotion* is further complicated by the existence of Edwards and Haime's genus *Petalaxis*. The name first appeared in the Permian and Carboniferous portion of the "British Fossil Corals,"‡ without definition, except that the authors refer the reader in a footnote to "under the name of *Nematophyllum*"—*i.e.*, to p. lxxi. of their "Introduction," where the latter and *Stylaxis*, McCoy, are united, the main point in the description being that the corallites are provided with a "well-developed interior wall," and so distinguished from *Lithostrotion* (*Lithodendron* in *in eodem loco*). So far so good; but on a previous page of the same part of their Monograph,§ Edwards and Haime had already disposed of *Stylaxis* by rendering it synonymous with *Lithostrotion*. To this last genus they had also united *Nematophyllum* in their "Polypiers Fossiles"‖—a work, be it remembered, in date between the "Introduction" and the third part of the "British Fossil Corals," in which the Permian and Carboniferous species are treated of. What, therefore, becomes of *Petalaxis*? Is it a genus without definition, or does the definition above referred to stand, minus McCoy's two names? One is not in any way assisted out of the difficulty by Edwards and Haime's remarks on a subsequent page¶ of their "Third Part" under the species *P. Portlockii*.

I am induced to insert these observations on *Petalaxis* because Mr. A. Stuckenberg has referred** a number of Russian Carboniferous corals to it, which, so far as I can understand his remarks (with the

* Corals Carb. Syst. Scotland, 1883, pp. 104, 107, 111.
† Brit. Foss. Corals, Pt. 3, 1852, p. 193.
‡ Pt. 3, 1852, p. 204.
§ P. 192.
‖ 1851, p. 432.
¶ P. 205.
** Mém. Comité Géol. Russie, 1888, V., No. 4, p. 20; *Ibid*, 1895, X., No. 3, p. 74.

kind assistance of a lady now in Sydney, and formerly long resident in Russia), appear to me to be very closely allied to the Queensland species now under discussion. At the same time the latter differ from the supposed conception of *Petalaxis* in an important character, for in their type *P. maccoyanum** Edwards and Haime say the primary septa "atteignant presque a la columelle a laquelle toutfois elles ne soudent jamais." For the same reason the Russian corals, or at any rate some of them, described by Stuckenberg, do not belong to *Petalaxis*.

Again, Trautschold rejects *Petalaxis*, on the grounds that its structure does not differ from that of *Lithostrotion*.† He remarks that the authors (Edwards and Haime) placed the species of McCoy's *Stylaxis* with *Lithostrotion;* with equal justice their *Petalaxis* must be placed with the same, for the transverse section of *S. irregularis*, McCoy, is not essentially different from their figure of the tranverse section of *Petalaxis Portlockii*. In both, the thin leaf-like columella appears only as a continuation of the radial lamellæ [septa]. It will be noticed that Trautschold here refers, in common with Mr. J. Thomson, to the intimate connection between the columella and primary septa.

Lastly, the late Professor F. Roemer, on the other hand, adopted *Petalaxis*,‡ his definition being practically the same as that of Edwards and Haime (as *Nematophyllum)*, remarking that the general habit of the genus is that of a massive *Lithostrotion*, but the peripheral vesicular structure of the corallites in *Petalaxis* separating them.

As I have said before, the solution of these generic difficulties must be left to abler hands than mine; but if future investigation should demonstrate that either of the genera formed by the late Sir F. McCoy cannot be conveniently adopted,§ in the event of it becoming necessary to split up *Lithostrotion*, and that *Petalaxis*, Edwards and Haime, has no existence, then for corals possessing a similar structure to that shown in the three Queensland species, I would suggest the name of *Cantharophyllum*.‖ I believe that those species with a peripheral vesicular tissue, more or less cutting off the septa from the walls, and with the complicated septo-columella structure, should be separated from more strictly typical forms of *Lithostrotion*. In the light of Mr. Stuckenberg's figures, my two fasciculate species exhibit a departure towards *Lithostrotion*, and the compound one to *Petalaxis*, as the latter is understood by him.

The following are the abbreviated characters of the three species:—

Lithostrotion? columnare, *sp. nov.*

(Pl. i., fig. 1; Pl. ii., fig. 1-5.)

Sp. Char.—Corallum composite, large. Corallites astræiform, long, straight, with an average diameter of 10 mm.; walls incomplete, of variable character, compact, broken-up, or as a line of vesicles filled with secondary deposit. A peripheral zone of lenticular vesicular structure exists, of variable width and development, the vesicles

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* Polyp. Foss. Terr. Pal., 1851, p. 453.

† Nouv. Mém. Soc. Imp. Nat. Moscou, 1879, xiv., Livr. 1, p. 36.

‡ Lethæa Geog., 1 Theil. Lethæa Pal., Lief. 2, 1883, p. 387.

§ I do not overlook the fact that Edwards and Haime abolished *Stylaxis*, on the grounds that multiplication of corallites did not take place by fission, as described by McCoy.

‖ κάνθαρος = a beetle.

upwardly and inwardly arched, separated by an inner-mural investment from a second vesicular zone surrounding the columella, the vesicles upwardly and outwardly arched. Septa numerous, 40-48, primary and secondary, thickened, the proximal ends of the former either not visible in the peripheral tissue, or, pursuing an irregular course, sometimes confluent with those of contiguous corallites, but not geniculate, grouped, the resulting combinations distally proceeding directly to the columella, and uniting with it; secondary septa about one-half the length of the primary. Dissepiments (cut edges of vesicular tissue) in the peripheral zone exceedingly irregular, but those around the inner-mural investment, forming regular cycles, six being the ordinary number. Columella as a more or less continuous and thickened rod, the discontinuity apparently caused by vesicular structure, and forming in conjunction with the primary septa united to it a markedly radiate body; primary columella styliform, joined by two of the primary septa from opposite sides. Gemmation inter-mural.

Obs.—The interception of the septa towards the periphery of each corallite by a zone of vesicular tissue allies this species to *L. Portlockii*, Ed. and H., and *L. cyathophyllia*, Thom., but it is a larger and more robust form than either of these, and also differs in other particulars. *L.? columnare* is even more closely allied to *Petalaxis stylaxis*, Trauts., as figured by Stuckenberg.* In this coral the vesicular zone is visible, and a union of the primary septa with the columella, two of the former joining the latter from opposite sides in direct alignment. These structures are admirably shown in Mr. Stuckenberg's figures, both in sections and weathered specimens. The septa in the Australian species, are, however, much more numerous than in the European. The former is equally near to one Mr. Stuckenberg identifies as *P. Portlockii*, Ed. and H., in which the peripheral tissue is composed of very large and scanty vesicles, assuming quite a *Lonsdalia*-like appearance. In the face, however, of Edwards and Haime's statement that the primary septa in the type species (*P. maccoyanum*) never join the columella, I quite fail to see how those of Stuckenberg's species exhibiting this character, can, with propriety, be referred to *Petalaxis*.

A very marked variation takes place in the structure of some corallites of *L.? columnare*. So different is this from the typical condition of the species, that were it not that the two conditions occur together in the same corallum, grounds for a specific variation would present themselves. This variation consists of a large, loose, and sparse vesicular tissue in the peripheral zone (like that of *Petalaxis Portlockii*, Stuck.), and a reduction of the septa to thirty-two.

Lithostrotion? arundineum, *sp. nov.*

(Pl. i., figs. 3 and 4; Pl. ii., fig. 6.)

Sp. Char.—Corallum fasciculate, large. Corallites long, straight, parallel, close, often in contact for longer or shorter distances, round or oval, 4 to 5 millimetres in diameter; thinly epithecate, with delicate accretion swellings, but no outgrowths. Walls complete, but thin and inconspicuous. A narrow peripheral zone of lenticular dissepimental vesicles is present; the vesicles convex inwards and

* Mém. Comité Géol. Russie, 1888, V., No. 4, t. 3, f. 17-21.

upwards, the distal boundary indicating the position of the inner-mural investment, and an inner but not copious zone surrounding the columella, the component vesicles next to the latter dome or tent-shaped (in longitudinal section), the outer variable in shape, but resembling irregular and incomplete tabulæ. Septa numerous, 40, straight, thickened at their bases only, of two orders, grouped, the resulting combined septa joining the columella, the single or ungrouped stopping short of the latter, and their distal ends reuniting to form a partial ring; secondary septa less than half the length of the primary. Dissepiments much more evenly distributed than in *L.? columnare*. Columella thickened, round, oval, or fusiform, radiate as in *L.? columnare*, but not vesicular; primary columella styliform, joined by two of the primary septa from opposite sides. Gemmation lateral.

Obs.—In its mode of growth and long, straight corallites this species resembles *Lithostrotion junceum*, Fleming, and to some extent the more regular forms of *L. irregulare*, Phill.

LITHOSTROTION? STANVELLENSIS, *sp. nov.*
(Pl. I., fig. 5; Pl. II., figs. 7 and 8.)

Sp. Char.—Corallum irregularly fasciculate, or inclined to cæspitose. Corallites long, irregular in their growth, not often parallel, but curving, and somewhat gnarled, occasionally in contact, 8 to 10 millimetres in diameter; epitheeate, with strong accretion swellings, but no outgrowths; walls complete, and stronger than in *L.? arundineum*. A peripheral narrow zone of lenticular dissepimental vesicles is present, but wider than in the species just mentioned; the vesicles convex inwards and upwards, again indicating the position of the inner-mural investment, which is at times not otherwise strongly marked; vesicles of the inner zone surrounding the columella very copious, large, and simply lenticular, convex inwards and outwards. Septa very numerous, 60, straight, thickened, of two orders, grouped and connected with the columella as in *L.? arundineum;* secondary septa short. Inner-mural investment variable in appearance, at times thickened, at others barely perceptible. Columella as in *L.? arundineum*. Gemmation lateral.

Obs.—This species when not cæspitose, to some extent approaches *L. affine*, Flem., and *L. Phillipsi*, Ed. and H., in its mode of growth, but I have not observed the connecting processes so characteristic of the latter, giving to it the outward appearance of a *Syringopora*. When the corallum is more tuft-like, it approaches *L. cæspitosum*, Martin (*L. Martini*, Ed. and H.). In vertical sections it may be at once distinguished from *L.? arundineum* by the nature of the vesicular tissue surrounding the columella.

Genus Koninckophyllum, *Thomson and Nicholson*, 1876.
(Ann. Mag. Nat. Hist., 1876, xvii. (4), p. 297.)

KONINCKOPHYLLUM INOPINATUM, *sp. nov.*
(Pl. I., fig 2; Pl. II., figs. 9 and 10.)

Sp. Char.—Corallum simple, robust, conical or turbinate, straight, with an average height of $1\frac{3}{4}$ inches; sometimes flattened at the base for attachment. Epitheca not preserved, but probably thin. Depth

of calice unknown, but apparently shallow, and with a round, everted margin. Septa very numerous, although variable in number in different individuals, and well developed (as many as 198 primary and secondary have been counted), straight, tapering, and direct to within a short distance of the columella, but not reaching the latter; secondary septa about half the length of the primary. Interseptal loculi filled with a highly copious development of delicate, close set dissepiments convex outwards (in horizontal section), but sometimes slightly anastomosing or reticulate, particularly towards the distal ends of the loculi, which are placed at about half the diameter of the corallite; in a longitudinal section the dissepiments are seen to form an equally copious tissue of lenticular vesicles, their convexities directed upwards and inwards, giving rise to an exterior zone in the corrallum of an exceedingly dense and minute structure. Columella oval, stout, and rod-like, non-cellular, extending the entire length of the visceral chamber. Tabulæ vesicular and very plentiful, entirely confined to the central area around the columella, the component vesicles with their convexities upwards and outwards, and at times becoming more or less tent-shaped.

Obs.—The genus *Koninckophyllum* was established by Messrs. J. Thomson and Alleyne Nicholson for the reception of "certain corals from the Carboniferous rocks of Scotland, which present a combination of characters peculiarly their own, and which may be regarded as, in some respects, intermediate between *Cyathophyllum* and *Lithostrotion*."

The corallum in *K. inopinatum* is short-conical or turbinate, and in one specimen there is distinct evidence of a slightly curved and flattened or spreading base of attachment. I have not seen sufficient of the epitheca to be able to speak with precision, but I believe it to have been thin, for all the specimens are decorticated and abraded externally. In the best preserved example the calice margin is thick, rounded, and more or less everted.

The septa vary greatly in number in different individuals. Counting both primary and secondary together, there are in one corallum 96, in a second 106, in a third 112, in a fourth 188, and in a fifth 198.

The dissepiments are exceedingly numerous, and form a densely packed peripheral zone; at the inner ends of the loculi there is a tendency to anastomosis.

The tabulæ when viewed transversely appear to occupy a much more circumscribed area than in the Scotch species of the genus. In consequence of their highly vesicular nature cut edges are common when so seen.

The characteristic aspect of this coral, in common with its fellow species, is in a longitudinal section prepared for the microscope. In the first place there is the peripheral zone of dissepimental tissue, the component vesicles directed upwards and inwards. This is followed by the vesicular tabulæ, so vesicular in fact as to almost warrant the disuse of the word tabulæ in this instance. Those contiguous to the dissepimental tissue are of irregular form, but the others nearer to the columella assume a lenticular outline, and it not infrequently happens that the inclination towards the columella is such as to convey to them a more or less tent-shaped outline. Lastly occurs the columella as a thickened rod, but variable in breadth throughout its course.

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III.—CONCLUSION.

In his first Report Mr. Dunstan refers to the presence in the Lion Creek Limestone of "the corals *Syringopora*, *Stromatopora*, and *Phillipsastræa*," and remarks—"The latter has not previously been known to occur in the Gympie Formation, and is quite new even to the Permo-Carboniferous System in Australia."* Mr. Dunstan might also have extended the same remark to *Stromatopora*. In his second publication he further remarks—"The limestones contain a number of corals which previously had only been known to occur in Queensland in formations which are classed as Middle Devonian."†

So far as I have had an opportunity of examining the Lion Creek corals I have seen neither *Phillipsastræa* nor *Stromatopora*. I say "so far," advisedly, for no doubt the forms seen by me do not represent anything like the coral-life of the deposit.

The presence of the first of these genera in no way invalidates the age assigned to the beds described by Dunstan, but as to that of *Stromatopora*, I must confess myself sceptical. All three genera are known to occur in the Siluro-Devonian rocks of New South Wales, but I have not yet seen either *Syringopora* or *Phillipsastræa* from the Devonian of Queensland.

Mr. Dunstan's second statement is certainly not borne out by an examination of the corals. No doubt that termed *Phillipsastræa* above, is the compound *Lithostrotion* ? *columnare* of the present paper, indeed, I was for a long time in doubt about its generic affinities, as Mr. Dunstan is aware; the *Koninckophyllum* is essentially a Carboniferous form, and so is *Michelinia*, provided the determination be correct. Neither of these, nor *Stenopora*, has come under observation from the Queensland Devonian, the last-named being itself highly characteristeric of the whole Eastern Australian Permo-Carboniferous.

Neither *Fistulipora* nor *Hexagonella*, whichever the coral may prove to be, has previously been known to occur on this side of the Continent. The first of these elsewhere ranges from the Silurian to the Carboniferous, the second is purely a Permo-Carboniferous genus.

With the exception of *Stenopora*, and a few solitary examples of the Zaphrentoid group, coral-life in the Permo-Carboniferous of New South Wales is conspicuous by its absence, but in the Carboniferous of the Somerton area there is a much more prolific development, although at present our knowledge of the latter is of too limited a nature to enable a comparison to be made with the species of Lion Creek.

As a last fact it may be mentioned that in the discovery of the forms tentatively referred to *Lithostrotion*, we obtain the first evidence of reef-building corals in our uppermost Palæozoic rocks.

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* *Loc. cit.*, C.A., 1898, p. 18.
† *Loc. cit.*, Bull, G.S.Q., No. 11, p. 5.

EXPLANATION OF THE FIGURES.

PLATE I.

LITHOSTROTION ? COLUMNARE, *Eth. fil.*

Fig. 1.—Two corallites and portions of two others in transverse section, exhibiting vesicular walls, primary septa passing from corallite to corallite, others grouped, and all joining the thickened oval columella, with the primary style in the centre of the latter; also the dissepimental tissue—× 4.

KONINCKOPHYLLUM INOPINATUM, *Eth. fil.*

Fig. 2.—Longitudinal section of part of a corallum, exhibiting the thickened columella, septa in the lower portion, vesicular tabulæ in the upper, and the peripheral vesicular tissue at the sides—× 4.

LITHOSTROTION ? ARUNDINEUM, *Eth. fil.*

Fig. 3.—Portion of a characteristic specimen, with long nearly straight and parallel corallites—½ nat.

Fig. 4.—Longitudinal section of part of a corallite, with thickened columella, tent-like vesicular tabulæ, inner-mural investment, and peripheral vesicular tissue—× 3.

LITHOSTROTION ? STANVELLENSIS, *Eth. fil.*

Fig. 5.—Portion of a corallum, exhibiting the irregular corallites, some from the exterior, others in transverse or longitudinal section.

SYRINGOPORA SYRINX, *Eth. fil.*

Fig. 6.—Portion of a weathered surface of a corallum, exhibiting a transverse view of the corallites—× 2.

Fig. 7.—Portion of a corallite seen in longtitudinal section with the highly thickened walls, absence of endothecal tissue, and the septa in section — × 8.

Fig. 8.—A similar section to Fig. 7, with the cut ends of the septa — × 8.

Fig. 9.—Transverse section of four corallites, and portions of three others, showing the highly thickened walls, numerous irregularly developed septa, and in one instance an endothecal tube or cut concave tabula — × 6.

STENOPORA LEICHHARDTII, *Nich. and Eth. fil.*

Fig. 10.—A few corallites in transverse section exhibiting a regular polygonal outline, slightly thickened walls, and destitute of acanthopores — highly magnified.

Fig. 11.—A similar section, in which the walls are so much thickened that the polygonal outline of the corallites is lost, and the walls traversed by numerous and large acanthopores — highly magnified.

Fig. 12.—Another similar section, in which some of the acanthopores are so highly developed that the outline of the corallites is rendered still more irregular — highly magnified.

PLATE II.

LITHOSTROTION? COLUMNARE, *Eth. fil.*

Fig. 1.—Three corallites in transverse section, etched, showing portions of defined and continuous walls — × 3.

Fig. 2.—Portions of three corallites in transverse section, showing a continuous defined wall, and primary septa passing through the peripheral tissue, some alternate in contiguous corallites, others in apposition — × 3.

Fig. 3.—Portion of a corallite seen in longitudinal section, exhibiting the columella, the interior vesicular zone, and the peripheral lenticular vesicles — × 3.

Fig. 4.—A similar section to Fig. 3, but excentric, showing the septa, dissepimental vesicles, and peripheral lenticular vesicles — × 2.

Fig. 5.—A variety of this species in which the septa are much less in number, and the whole vesicular tissue much larger in proportion, and more open. (N.B.—This occurs in a section in which the other corallites are normal.) — × 4.

LITHOSTROTION? ARUNDINEUM, *Eth. fil.*

Fig. 6.—Transverse section of a corallite, showing the columella, septa, and vesicular tissue — × 5.

LITHOSTROTION? STANVELLENSIS, *Eth. fil.*

Fig. 7.—Transverse section of a corallite, the septa, ring around the columella, and vesicular tissue — × 4.

Fig. 8.—Longitudinal section of a corallite, exhibiting the columella, septa, vesicular tabulæ, and peripheral vesicles — × 3.

KONINCKOPHYLLUM INOPINATUM, *Eth. fil.*

Fig. 9.—The corallum, in elevation, with the rounded everted calicular margin.

Fig. 10.—Transverse section of the corallum, showing the large number of septa, columella, and dissepimental tissues — × 3.

SYRINGOPORA SYRINX, *Eth. fil.*

Fig. 11.—Portion of the weathered surface of a corallum, exhibiting corallites longitudinally, some in the round, others in natural section — × 2.

OOLITIC LIMESTONES FROM LION CREEK, STANWELL, NEAR ROCKHAMPTON.

By G. W. CARD, A.R.S.M., Mineralogist to the Geological Survey of New South Wales, Sydney.

(*PLATE III.*)

In appearance these limestones vary from light to dark grey, and generally display their oolitic character clearly. The weathered surfaces are fairly even, the granules as a rule not showing in marked relief. The granules are pretty closely packed in a calcite matrix, sand grains and fragments of calcareous organisms being sometimes interspersed with them. They are well nucleated, and are spherical in shape when their development is at all advanced. Their formation can be traced from irregular grains round which only a pellicle of carbonate of lime has been deposited to spherules in which the original shape has been obliterated by increased deposition in the concavities, and the nucleus replaced by structureless carbonate of lime or by calcite. They are concentrically zoned, but show no black cross, and rarely exhibit more than an indication of radial structure. The granules are all of one class, there being no scattering of smaller ones in the interspaces, as is the case with some oolites.

The nuclei are relatively large, and are conspicuous in hand specimens. While generally consisting of an organic fragment, frequently recognisable, or of some other form of carbonate of lime, particles of fresh lava, grains of corroded quartz (from a quartz-porphyry), and crystals of comparatively fresh felspar sometimes occur. The decomposition of the volcanic particles gives rise to yellow staining. Tubulation is not infrequent in the nuclei, but is absent or only very faintly indicated in the bands.

The granules often show indications of severe mechanical abrasion, the injury being sometimes partially repaired by the deposition of fresh material. They may also intrude on one another.

The following is a description of the specimens selected for examination*:—

111. Dark-grey, with a prevailing buff tint on weathered surfaces due to the oxidation of the ferruginous nuclei. Breaks with a hackly fracture, showing glancing calcite faces on the fresh surface. Weathered surface flat. The oolitic character not evident on a fresh fracture, but prominently so on weathered surfaces; the relatively large size of the nuclei being also apparent. Average diameter of granules, 1 to 2 mm.

Under the microscope, the granules are seen to be close—sometimes crowded—together, with calcite between. Every stage of formation, from an irregular calcareous fragment with a skin of carbonate of lime to a spherical granule with no determinable nucleus, is shown. The nuclei comprise igneous particles, felspar, calcite, fragments of organisms, and earthy carbonate of lime; tubulated

* The serial numbers are those of the Geological Survey of Queensland, attached to the specimens.

structure is sometimes shown. The igneous particles are indeterminable, owing to decomposition; quartz, felspar, and minute felspar microlites are sometimes visible. The felspar comprises some clear plagioclase. The majority of the granules have, or appear to have had, an organic nucleus. The granules themselves, when in an advanced stage of development, show concentric rings mottled with dark blotches; these latter being more abundant in the outer rings, which are lighter in colour than the inner.

[Amongst the organic fragments forming nuclei are portions of stem-joints and arm ossicles of Crinoids, sections of the valves of Mollusca, nautiloid shells resembling the tests of Foraminifera, minute tubes closely allied to *Girvanella*, and fragments of a coral—either Monticuliporoid, Stenoporoid, or Favositoid; it is difficult to say which.—R.E.]

127. Almost black, with white mottling; weathering brown. Fracture uneven. Quartz grains are visible. The oolitic character is only noticeable on weathered surfaces. The rings weather lighter than the nuclei. Average diameter of granules from one-third to one-half millimetre.

Under the microscope the granules are seen to lie in a matrix of crystalline calcite; they are not crowded. In general they show a nucleus of comparatively large size, usually organic. The nuclei are generally recognisable, and comprise crystalline calcite, granular carbonate of lime showing diffused polarisation effects, fragments of calcareous organisms and rounded grains of lava. The lava grains are common. They show numerous microlites fluidally arranged in a buff-coloured glass. Frequently the lava grains have only a pellicle of carbonate of lime, which conforms to their outline; the intermediate stages can be traced between these and well-developed granules to which they constitute nuclei: the formation of the granule is accompanied, however, by the accumulation of mineral staining in the nucleus. It would seem as if sand grains were continually being added to the unconsolidated material, and that the source from which they were derived was a fresh lava-flow. In addition to the lava, another igneous rock, more decomposed, of a coarser texture, and not fluidal in structure, has contributed sand grains. A little brown chalcedony and an occasional grain of angular quartz also constitute nuclei, or occur in the matrix. The quartz is quite clear and free from inclusions. Tubulated nuclei are present (Pl. III., fig. 4). The granules exhibit every stage in development. In the early stages the conformity of the enveloping material to the outline of the grains is well shown, with the usual tendency to a thickening over the concavities; the irregularity is in this way gradually reduced to a minimum. Towards the edges, where the thickness of the slice is less, the concentric zoning becomes less apparent, and a radial structure, due to rods of clear material traversing the rings, may even be revealed. With a $\frac{1}{4}$-inch objective, such a thin granule is seen to be sharply marked off from the matrix, but without the intervention of a distinct skin. In the matrix, moreover, there are nebulous patches of material resembling that of the granules, but containing areas lighter in colour, and it is to the disposition of these latter that the radial structure is due. It would almost seem as if the concentric appearances may be to some extent

due to staining rather than to a regular deposition of material. The granules are sometimes broken, with subsequent partial renovation. The concentric rings are not continuous all round, but pass into a region where their identity is lost. A ring of dark material sometimes occurs, and black spots may appear on both nuclei and rings. Instances occur of the mutual interference of two or more granules, one appearing to slightly penetrate the other.*

The slice is traversed by veins of calcite, which sometimes run in bands. These veins cross granules and matrix indifferently, but have not occasioned displacement. Quartz grains in the matrix are also traversed by them. Sometimes such a crack, when traversing a granule, will temporarily deviate from its course and follow the concentric zoning. In such a case it is evident that zones of weakness exist in the granule, and that it consists of successive shells.

[The organic fragments consist of *Girvanella*-like tubes, nautiloid and other bodies possibly Foraminifera, and the same coral as in the preceding section.—R.E.]

109. Light-grey in colour, both on freshly fractured and on weathered surfaces. The oolitic character is always evident. The granules are crowded together, and range up to 2 mm. in diameter. The nuclei are large, weather buff, and stand up in relief on weathered surfaces. Veins of calcite traverse the rock. Under the microscope the granules exhibit every stage from spherules consisting of grey, practically amorphous carbonate of lime right to the centre, to sand grains round which deposition has only just commenced and the original outline is still perfectly preserved. They are generally well defined, there being no gradual passage into the matrix. The peripheral region is usually marked by a dark skin, but may be nebulous.

Concentric zoning is well marked. In the more perfect instances it can be seen to consist of alternations of light-coloured sub-crystalline, and darker amorphous bands, still darker lineation being sometimes interpolated. Brown mineral-staining generally affects the granules more or less. Two or more granules may be partially enveloped in the same mantle.

Instances of mechanical injury are common, considerable portions of the granules being sometimes torn away, leaving an uneven, more or less brown-stained edge. The portions thus torn away can sometimes be seen lying in the matrix at no great distance from the parent granule. Another individual may be intruded into the breach. The injuries thus occasioned may be more or less completely made good by the accession of fresh material, but the old line of fracture still remains. The gradual obliteration of the outlines of the nuclei and approximation to the spherical shape due to greater deposition opposite the concavities, a feature already noticed in Specimen 127, is well shown. In this slide, as in others, the concentric lineation is by no means continuous, the granules generally having one or more regions in which the zoning cannot be traced.

The nuclei are in a rather advanced stage of decomposition. Volcanic particles are present, and it is to the decomposition of these that the brown staining is due. Organic fragments predominate; but no tubulation is shown in this slice. Two or more nuclei may be

* Such interpenetration has been noticed by G. F. Harris in the Lincolnshire Limestone. Proc. Geol. Assoc., xiv., Pt. 2, p. 75.

present in one granule. The matrix consists of crystalline calcite, and does not contain foreign particles.

The experiment was tried of treating a portion of the slide with very dilute hydrochloric acid, after the removal of the balsam, and watching the results under the microscope. The clear calcite of the matrix and of the nuclei was most readily attacked; action on the rings was not nearly so vigorous. As the attack proceeded the concentric appearances became more and more prominent. A drop of hot concentrated acid was finally added to ensure the complete decomposition of the carbonates. The residue practically consisted of the volcanic particles, and of the material of the *dark* rings. It would seem, therefore, as if these rings marked *periods of growth*, and are discoloured by the accession of minute quantities of foreign material. Such a layer as this would constitute the dark skin referred to above as frequently bounding the granules. The residue was much too fragile to admit of preservation.

[The only organism in the slightest degree determinable in this section is that of the margin of a coral calice, with a few inwardly projecting septa.—R.E.]

110. A grey rock displaying its oolitic character from every aspect. Yellow-stained in places, particularly the nuclei of certain granules. The granules are closely-packed, sub-spherical in shape; and have relatively large nuclei. Interspersed with the granules are fragments of calcareous organisms. The rock is traversed by calcite veins, and weathers to an even surface; the granules not showing in marked relief.

Under the microscope, the rock proves to be of considerable interest. The granules are distinct, with well-marked concentric rings, and the nuclei are frequently recognisable without difficulty. The nuclei consist, for the most part, of organic particles, or of grains of a fluidal lava. Occasionally, felspar (orthoclase ?) occurs as a nucleus, and in one instance a much-corroded quartz grain (*cf.* 108). In the case of both organic and volcanic grains, the passage into amorphous or sub-crystalline carbonate of lime (in the former), and into calcite (in the latter) is noticeable. When crystallised, the resulting calcite constitutes one individual. Occasionally a tubulated nucleus occurs (Fig. 1). The igneous particles are both colourless and yellow-stained. The felspar microlites are fresh and crowded together; their low extinction angle points to oligoclase. Two generations of felspar are sometimes present. The presence of calcareous patches may indicate an original vesicular condition, but this may be only a phase in the replacement of the grain by calcite. Apatite, in longitudinal and cross sections, associated with an opaque material, was noticed in one or two of the calcareous nuclei.

The granules are for the most part highly irregular in outline. They are frequently abraded, or abut against one another with mutual damage (Pl. III., fig. 1). Nuclei are not always present.

The cohesion of the concentric coats has not been very great, as it has permitted their separation, and the deposition in the interspaces of calcite, either in continuation with the veins traversing the rock, or as saddle-shaped masses without any apparent connection with the matrix (*cf.* 127). Yellow staining is frequent, peripherally, zonally, and irregularly. As in the other specimens, the development of the

granules can be studied in different stages of growth. A sort of radial structure, occasioned by radially disposed lighter areas is sometimes present. Apparently differentiated from the matrix are rounded areas, occupied by coarse-grained calcite, and sometimes yellow-stained superficially: these may represent grains of crystalline limestone. Calcite veins traverse the rock, slightly faulting the granules. The calcite patches of the matrix are sometimes interesting, as they represent two stages of growth; the whole being in optical continuity and traversed alike by the parting planes. The newer (outer) material is lighter and clearer than the older (inner) portion in such a case.

[Very rich in organic fragments, consisting of stem joints and arm ossicles of Crinoids, tubes resembling the corallites of *Syringopora*, three calices of the same genus, united in a line by exothecal tissue, forming a long nucleus, nautiloid Foraminifera and a small coral, probably Favositoid.—R.E.]

108. This rock has a prevailing light-grey tint; but the dark colour of many of the nuclei imparts a speckled appearance to cut surfaces. It weathers light-brown, with an even surface from which the granules stand up in relief. The granules are small, averaging less than half a millimetre. Under the microscope it is seen that consolidation must have taken place at a very early stage in the development of oolitic structure. The rock might almost be described as a sandstone with a calcareous matrix, round the constituent grains of which a coating (generally thin) of carbonate of lime has formed. This comparison is further strengthened by the abundance of quartz and felspar grains present. The principal components are as follows:—

Quartz.—In angular or sub-angular grains of irregular shape. These exhibit pear-shaped or circular stony inclusions: in fact, they are corroded in the manner characteristic of the acid eruptives. They have generally received but a very scanty deposition of lime carbonate.

Felspar.—This is comparatively fresh or even quite clear. Idiomorphic orthoclase showing carlsbad twinning, and plagioclastic varieties with narrow twin lamellæ are represented.

Lava.—Where distinguishable these grains show numerous, very minute, fluidally-arranged felspar microlites in a yellowish base. Many other nuclei, now deeply stained, undoubtedly are also of volcanic origin.

Organic fragments and *crystalline calcite.*—Calcite nuclei generally exist as individual crystals, but occasionally as aggregations.

Felsite.—A little doubtful.

Chalcedonic silica.

[Beyond a few stem joints of Crinoids there are no organic remains of importance in this slide.—R.E.]

The collection of the Geological Survey of Queensland also contains an excellent example of an Oolitic Limestone, said to be from the Upper Silurian rocks of the Yass District, New South Wales.

In hand specimens the colour of the limestone is a dark grey-blue; it breaks with a somewhat hackly fracture, but on weathered surfaces the component "grains" are seen in natural section. The disposition of the grains in the cementing medium of clear calcite is

irregular, a few are sufficiently close to touch one another, although they are mostly separated by variable interspaces, but none are so far apart that the cementing clear calcite becomes apparent to the naked eye.

The grains are either oval or round, and the concentric structure is exceedingly regular. While on one side the cross-sections are spherical (or sub-spherical), in the other they are elliptical with the longer axes parallel. This may, perhaps, indicate a fusiform outline.

The rings are close together, but with faint indications of clear calcite between them, producing a pleasing contrast of colours, the concentric structure growing less and less marked towards the centre, the latter becoming more homogeneous in structure and often lighter in colour. In no single instance has any recognisable organic nucleus been observed, and only in a few instances has foreign matter of any kind, or even a clear calcite centre been seen. Again, in only one instance has an organism been observed even within one of the grains, the foreign body in this instance consisting either of a very small branching coral or a polyzoon, the irregular outline of this particular grain arising from the nature of the fossil.

The general structure of these grains is granular-concentric, a faintly radiate appearance becoming visible towards the centre of some, but only markedly so in one instance, and then only under a low power with ordinary light. The composition, therefore, is very finely granular unoriented matter.

The interstitial portions of the rock are filled with clear granular calcite, and immature grains more or less rounded.

The granules are generally bounded by a dark skin, and are sometimes abraded, more particularly along the lines of contact. Mutual interference during growth has sometimes given rise to apparent or actual interference. Portions of the matrix have sometimes been involved with the rings of growth. In one case (Pl. III., fig. 5) some of the smaller granules have been included in a larger one. It would seem as if both sets of granules and the crystalline matrix were in simultaneous course of formation. The granules are peppered over with black spots.

The average size of the grains is two mm. in shortest diameter, and the sp. gr. of the rock 2·70, thus indicating that the lime is in the form of calcite rather than arragonite.

The following analysis is by Dr. Thomas Cooksey, B.Sc., formerly Mineralogist and Chemist to the Australian Museum, Sydney:—

Iron oxide	·40
Lime	50·84
Magnesia	·34
Carbonic acid	40·07
Residue	9·08
	100·73

The residue appears to be wholly silica.

Sorby says* that the three chief types of oolitic grains are the concentric, radiate, and recrystallised. The Yass rock certainly appertains to the first of these, the non-obliteration of the concentric layers pointing to the absence of any recrystallisation.†

* Quart. Journ. Geol. Soc., 1879, xxxv., p. 46.
† *Ibid.*, p. 75.

On treating the Yass Limestone with hydrochloric acid, no traces of carbon remain, as described by Mr. Fulcher, who found that by dissolving the Hirnant limestone, from near Bala Lake, Wales,* as above, ellipsoids composed chiefly of carbon and silica were left.

I am not acquainted with any other Oolitic Limestone in New South Wales possessing a similar appearance and structure to this rock, with one exception. This is a rock of Carboniferous age at Brushy Hill, Page River, six miles east of Scone, the structure being truly oolitic, and the grains formed by concentric layers, without radiated structure; except in colour it closely resembles the Yass limestone.

Other localities yielding limestones of this nature in New South Wales and Queensland are—

1. The Yellow Rock Limestone, Upper Muswell Creek, Muswellbrook; it is bluish-grey in colour, with contained Crinoid stem joints, and is probably of Carboniferous age.†

2. Manning River, of similar geological position, and "containing numerous Foraminifera."‡

3. At Bingara an oolitic limestone is associated with the bedrock of the goldfield, containing *Lepidodendron australe*, McCoy,§ and therefore of Lower Carboniferous age.

4. At Rocky Creek, Horton River, an exceedingly interesting fragmental limestone occurs containing fragments of felspar crystals, shells, corals, and oolitic grains sparsely distributed throughout, although here and there arranged in clusters. Many of the fragments, particularly the felspar, act as nuclei, surrounded by narrow envelopes of concentric calcareous matter. In only one grain was true radial structure observed, the grain in question showing a distinct black cross with polarised light. Specimens of both this limestone and that from Yellow Rock were presented to the Australian Museum by Professor T. W. E. David.

5. At Mount Siluria, four miles south-west of Gracemere, west of Rockhampton, an oolitic limestone occurs, very closely resembling the Yass rock. It weathers out in four-sided prismatic pieces. The process of weathering reveals the oolitic grains perfectly, bringing out the concentric structure, and showing the presence of organic fragments. The fusiform shape of the granules is demonstrated by the sections presented on the sides of the prisms; for instance, these may be more or less flattened spheres at the ends, elliptical on two sides, and imbricating closely-packed lenticles on the other two. While these appearances may at first suggest deformation, due to pressure, no indications whatever of mechanical stresses are noticeable under the microscope. The granules sometimes attain dimensions of more than 3 millimetres. They are concentrically banded to a high degree. Nuclei are rare; but occasionally a particle of calcite, more or less recognisable as an organic fragment, serves in this capacity. Mutual interference of granules sometimes occurs when the boundaries become irregular, one of the individuals in contact suffering to a greater extent than the other.

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* Geol. Mag., 1892, ix. (3), pp. 115, 116.

† 1. David, Ann. Report Dept. Mines and Agric. N.S. Wales for 1886 (1887), p. 146.

‡ 2. David, Proc. Linn. Soc. N.S. Wales, 1895, x. (2), p. 489.

§ 3. Stonier, Ann. Report Dept. Mines and Agric. N.S. Wales, for 1894 (1895), p. 162.

6. Interesting limestones occur in County Murchison, New South Wales, Parish Horton. In one variety the granules are small, closely packed, and weather out in strong relief, imparting an exceptionally perfect oolitic appearance to the rock. The granules are dusky-brown by transmitted light, are seldom nucleated, and in many cases show no decided concentric structure. Another type possesses immature granules only. these are not in contact, and have as nuclei grains of angular quartz, biotite, plagioclase (sometimes perfectly fresh), or volcanic rock.

7. County Murchison, New South Wales. In Parish Pallal is a rock that can best be described as a fragmental limestone (organic). It contains numerous oolitic granules and shows *Girvanella*. Another limestone, in Parish Boomi, has more or less irregular nucleated granules of considerable size along with various fragments, some of which are of igneous origin. It also shows *Girvanella*.

8. Torryburn, Paterson, New South Wales. This exhibits small, very closely-packed granules, with large nuclei of calcite, quartz, felspar, sandstone, or volcanic rock. By reason of their being in close contact they often assume a rudely polygonal outline. In one variety the polygonal granules are bounded by an opaque black margin, which may perhaps prove to be of carbonaceous material, as in the rock from North Wales described by Fulcher.*

EXPLANATION OF THE FIGURES.

PLATE III.

Fig. 1. *Slide* 110.—1-inch objective — × 23 diameters. Stanwell Oolite showing grains of lava as nuclei. The large granule on the right-hand bottom edge has a well-tubulated nucleus. Concentric lamination in, and mutual transgression of, granules are also shown.

Fig. 2. *Slide* 108.—1-inch objective — × 23 diameters. Stanwell Oolite showing corroded quartz, altered lava, felsite and chalcedonic silica as nuclei, in addition to calcareous material. The quartz is occasionally idiomorphic. The rings are in a very early state of growth.

Fig. 3. *Slide* 1A.—Early stage of growth. 2-inch objective — × 12 diameters. Yass Oolite showing large spherical granules, non-nucleated, well laminated. The smaller granule in the centre is radial. The interspaces are occupied by smaller granules and calcite. Calcite veins traverse the slide without faulting.

Fig. 4. *Slide* 127.—1-inch objective — × 23 diameters. Stanwell Oolite. Granules with relatively large nuclei; that in the centre is tubulated. Lava grains are present, but are not readily recognisable.

Fig. 5. *Slide* 1B.—2-inch objective — × 12 diameters. Yass Oolite. A single granule; non-nucleated, well laminated. The outer layers have enveloped a portion of the matrix, including several of the small granules. (See Fig. 3.)

Fig. 6.—2-inch objective — × 12 diameters. Oolite from Mount Siluria, Rockhampton. For comparison with the Yass rock (Fig. 3) which it closely resembles.

* *Op. cit.*

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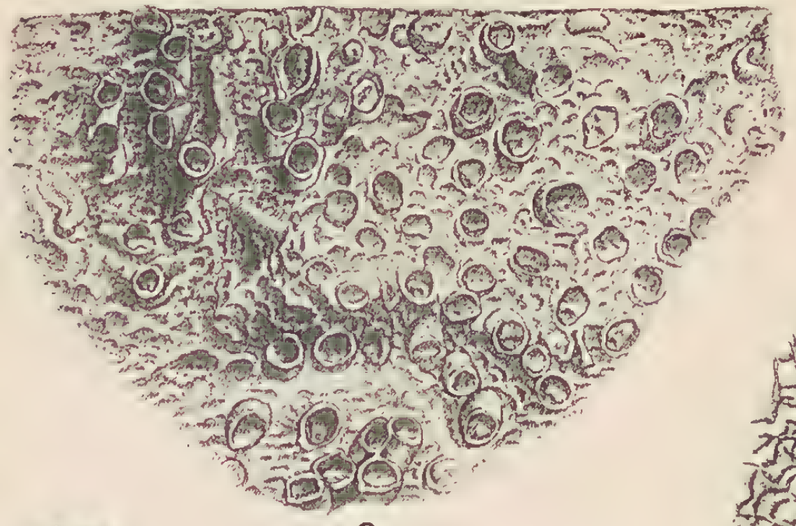

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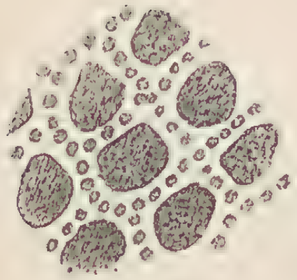

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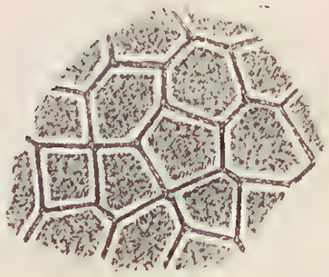

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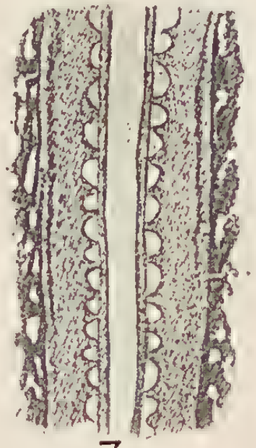

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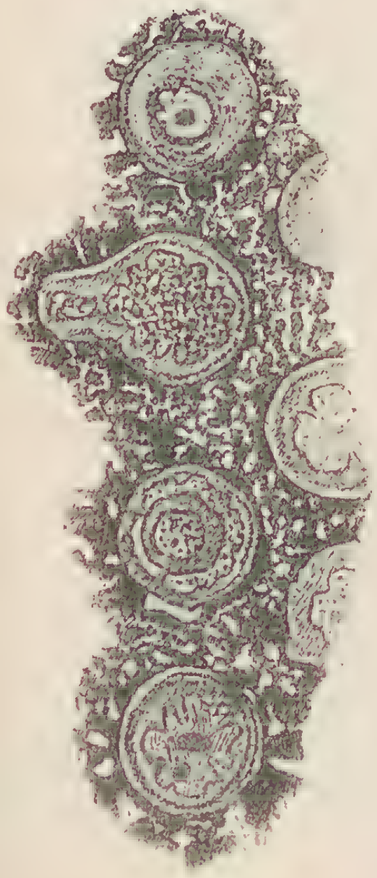

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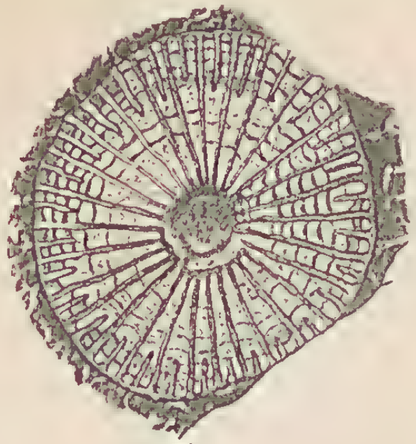

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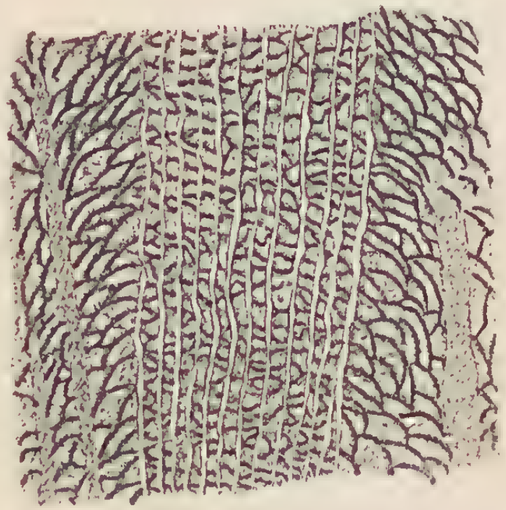

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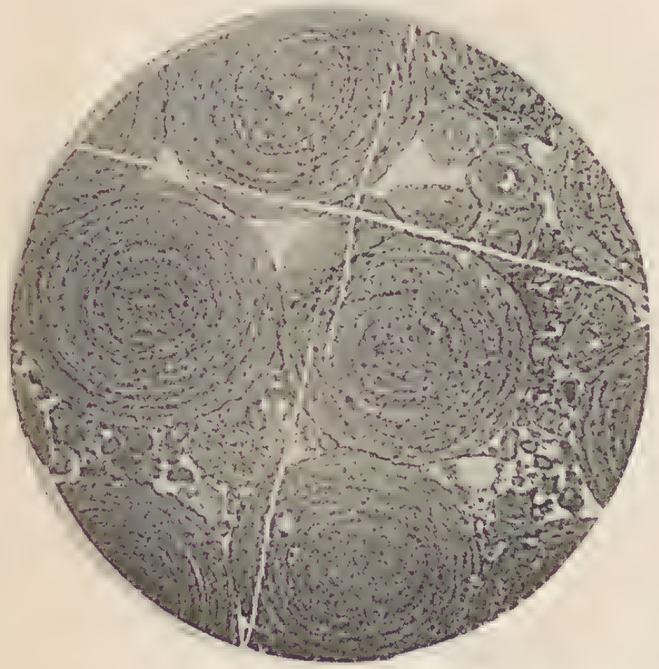

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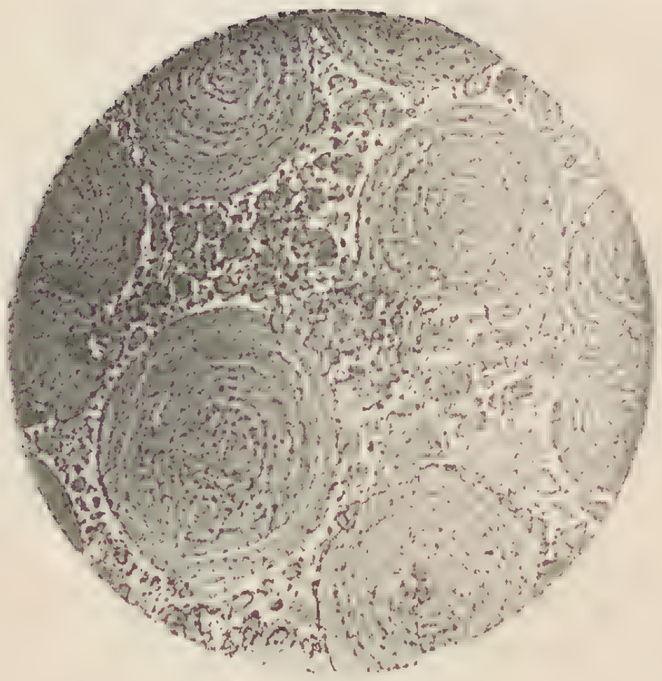

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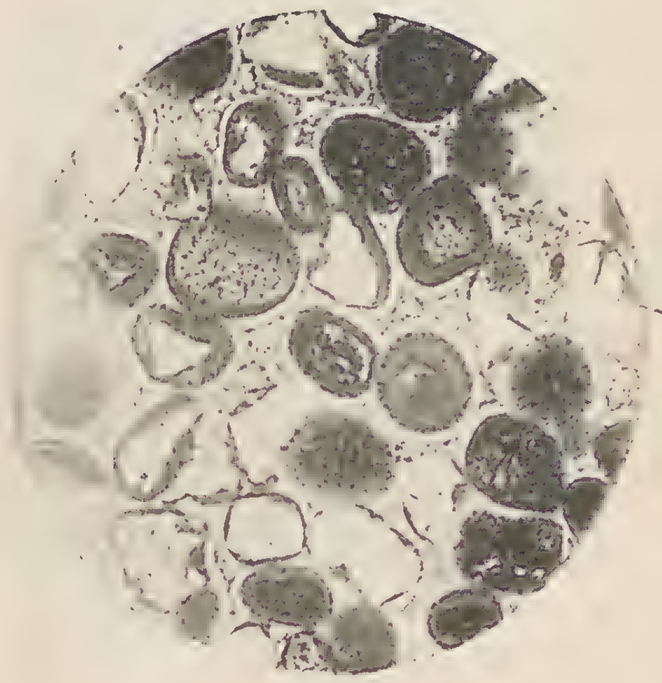

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Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 13.

ADDITIONAL NOTES

ON THE

PALÆONTOLOGY OF QUEENSLAND

(PART 2).

By R. ETHERIDGE, Junr.,

CURATOR OF THE AUSTRALIAN MUSEUM, SYDNEY.

WITH FOUR PLATES.

BRISBANE:

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1901.

LETTER OF TRANSMITTAL.

To The Honourable The Minister for Mines.

Geological Survey Office,
Brisbane, 19th March, 1901.

Sir,—

I have the honour to enclose a Paper by Mr. R. Etheridge, Junr., Curator of the Australian Museum, Sydney, entitled "Additional Notes on the Palæontology of Queensland, Part 2," with Four Plates, and to recommend that it be printed in pamphlet form as Bulletin No. 13.

I have, &c.,

WILLIAM H. RANDS,
Government Geologist.

ADDITIONAL NOTES ON THE PALÆONTOLOGY OF QUEENSLAND (PART 2).*

By R. ETHERIDGE, Junr., Curator of the Australian Museum, Sydney.

(WITH FOUR PLATES.)

I.—INTRODUCTION.

For a very long time I have had in my care a portion of the fossils collected in the Queensland Cretaceous area by Mr. G. Sweet, of Brunswick, Melbourne, and others forwarded to me at different times by Messrs. R. L. Jack (formerly Government Geologist) and W. H. Rands (Government Geologist). Pressure of official duties, and, in consequence, lack of spare time, prevented me from investigating these fossils as completely as I could wish until recently.

The following descriptions are either those of the more important species, or of specimens yielding fuller details of species already described by myself and others elsewhere. This paper may, therefore, be regarded as supplementary to the Cretaceous portion of the organic remains described in the "Geology and Palæontology of Queensland, &c.," by Dr. R. L. Jack and myself, published in 1892.

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It seems to be the fate of the student of Australian Palæozoic and Mesozoic Palæontology to be always confronted with either more or less fragmentary or ill-preserved material. This, moreover, in the case of any given fauna often reaches him at irregular intervals of time. As a result, his acquaintance with his species is very often acquired little by little, and it not infrequently happens that the first attempt to define a given form is not an unmixed success; such has very often been the fate of the writer.

II.—DESCRIPTION OF THE SPECIES.

SPONGIDA.

Genus Purisiphonia, *Bowerbank*, 1869.†

(Proc. Zool. Soc., p. 342.)

PURISIPHONIA CLARKEI, *Bowerbank.*

P. Clarkei, Bowerbank, Proc. Zool. Soc., 1869, p. 342, t. 25, f. 6 and 7.

P. Clarkei, Hinde, Cat. Foss. Sponges Brit. Mus., 1883, p. 124.

P. Clarkei, Hinde, in Jack and Etheridge's Geol. Pal. Q'land, &c., 1892, p. 438, t. 19 (for synonomy).

Obs.—The only other specimens in existence, besides the original ones used by Drs. Bowerbank and Hinde are, I believe, the present

* Part 1 appeared in 1891, in the *Proceedings of the Linnean Society of New South Wales*, IX. (2), p. 518, and comprised the Palæozoic additions.

† Emended Hinde, 1892.

examples in Mr. Sweet's cabinet. In Dr. Hinde's emended description of this interesting sponge, the form is said to be that "of a hollow stem giving off tubular branches." There is no trace in Mr. Sweet's specimens of any stem-like growth with hollow branches, so well shown in the original figures of Bowerbank and Moore*, but rather that of an oblong, pyriform body. There are, however, the same thick and robust walls and uneven surface, whilst the skeletal mesh and microscopic structure seem to be identical with that figured by Dr. Hinde.

The oscules are circular or elliptical, and there are several excellent examples of the manner in which the canals are formed by the interlacing and bending round of the spicular tissue. I am not, however, quite satisfied that some of the canals do not penetrate the spongy wall, contrary to the view expressed by Dr. Hinde.

One of the specimens, cut in natural longitudinal section, measures two and three-quarter inches in length by one and three-quarter inches in breadth. The walls possess a thickness of nearly half-an-inch, and the central vacuity is seven-eighths of an inch in diameter.

Loc. and Horizon.—Wollumbilla (the type locality)—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

ECHINODERMATA.

Genus Isocrinus, *Von Meyer*, 1837.†

(Mus. Senkenberg, 1837, p. 251.)

Isocrinus australis, *Moore*, sp.

(Pl. I., fig. 4; Pl. III., figs. 1-3.)

Pentacrinus australis, Moore, Quart. Journ. Geol. Soc., 1870, xxvi., p. 243, t. 17, f. 3; t. 18, f. 1.

Pentacrinus australis, Eth. fil., Cat. Austr. Foss., 1878, p. 105.

Pentacrinus australis, Eth. fil., Geol. and Pal. Q'land, &c., 1892, p. 439, t. 20, f. 1-3.

Sp. Char.—First radials short, exteriorly triangular; second radials also short, their transverse diameters greatly exceeding the longitudinal; third radials the largest, high, and axillary. Rays five, not in lateral contact; arms isotomous, of seventy or more divisions, fourteen or more to a ray; fixed brachials ($\bar{1}$ Br) small and node-like exteriorly; primibrachs (I Br), or monostichals (1 St) thirteen, the thirteenth primaxil (I ax), or monaxil (1 Ax); secundibrachs (II Br), or distichals (2 St) fifteen, the fifteenth secundaxil (II ax), or distaxil (2 Ax); tertiobrachs (III Br) and tetrastichals (3 St) present. First primibrachs (I Br_1), or first monostichals, (1 St_1) widely V-shaped along their ventral edges. Columnals with petaloid sectors.

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* Quart. Journ. Geol. Soc., 1870, xxvi., t. 17, f. 1.

† Redefined Bather, 1898.

Obs.—Specimens of this Crinoid collected by Mr. Sweet enable me to give a more extended description than that afforded by Mr. Moore, but the imperfection of the fossils still leaves much to be desired.

I have endeavoured to adopt Mr. F. A. Bather's terminology* as far as I possibly can, but this very imperfection and consequent doubt as to some of the structural points has rendered this attempt far from satisfactory. In nothing is this more apparent than in the terminology of the arms or brachia, in consequence of doubt as to the presence of pinnules on some of them, rendering the use of different terms necessary. For reasons to be subsequently given I have employed the double terminology suggested by Mr. Bather in his paper† just quoted.

In the first place the question of genus arises, but a solution of this is rendered comparatively easy by Mr. Bather's masterly article on the use and misuse of the name *Pentacrinus*.‡ *Isocrinus* is adopted for reasons to be given later.

From the appearance of Mr. Sweet's principal specimen, and the figures formerly published by Mr. Moore, I think there can be little doubt that *I. australis* possessed five rays. The specimen in question exhibits portions of this number, more or less attached to the dorsal cup, comprising seven out of the ten arms into which the rays divided, presuming the development to have been normal.

The first of Moore's figures§ is seen from the dorsal side, and consists of a columnal, the five isolated node-like fixed brachials (I Br), four of the first radials, the second and third radials of two rays, and the second in a fourth ray; the third radials are axillary. There are thirteen, fifteen, and fifteen primibrachs (I Br) respectively shown on three of the imperfect arms.

The second figure‖ represents *I. australis* seen from the interior of the dorsal cup, with portions of two rays attached to the latter. Separated by intervening matrix are other arm portions seen from the ventral side, arising in pairs from axillaries, and others represented by clusters of pinnules; the arms or brachia are therefore compound. Above the paired arm portions lie transversely two further series of pinnule-bearing ossicles that may be finials (F).

Mr. Sweet's principal specimen consists of a dorsal cup severed in half, and the dorsal portion removed, exposing the five first radials, and portions of five rays. The first radials meet one another at their ventral lateral margins round the dorsal cup, and form a partially complete ring. As I cannot satisfactorily orient this specimen, I purpose describing the rays one by one, from left to right as it lies before me. In the fractured section three of the fixed brachials (I Br) are visible, each wedged between the dorsal ends of two of

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* Ann. Mag. Nat. Hist., 1892, ix. (6), p. 51.

† Loc. cit., p. 60, par. 2.

‡ Natural Science, 1898, xii., No. 74, p. 245.

§ Moore's t. 17, f. 3. As there are no pinnules shown I use the Latin terminology in describing this and following figure.

‖ Moore's t. 18, f. 1.

the first radials, and projecting externally as small nobs or nodes. Of the first ray on the left of the specimen, only a few primibrachs (I Br) of one arm (a) remain, and need not be further referred to. The next ray is rather more perfect, retaining a few primibrachs of the left arm (β), and eleven ossicles or brachalia of the right (γ), with gaps from which two other pieces have fallen, or thirteen ossicles in all, the thirteenth being primaxil (I ax); the bifurcation is followed by four and seven secundibrachs (II Br) respectively. The succeeding ray is even more complete, and, like the preceding one, is definitely attached to the dorsal cup. In the left hand arm (δ) are twelve primibrachs (I Br), and a gap left by one that has disappeared, thus again rendering the thirteenth primaxil (I ax); the bifurcation is followed by five and two secundibrachs (II Br) respectively, and thence the remainder are missing. In the right arm (ϵ) of this ray, eleven primibrachs are preserved, and two vacuities are apparent, the terminal ossicle being axillary (I ax). The secundibrachs are represented by fifteen and three ossicles, left and right respectively, the fifteenth ossicle of the former being secundaxil (II ax) and supporting three tertiobrachs (III Br), of one arm. In the fourth ray the third radial is followed on the left arm (θ) by four monostichals (1 St), and on the right arm (i) by three, then occurs a wide gap caused by fracture of the rock, from which all the ossicles have disappeared, but the arms (θ and i) are again renewed at the monaxils (1 Ax), the distichals (2 St) of the left branch of θ being thirteen, whilst in the right eight only remain, the thirteenth of the former being distaxil (2 Ax); the latter affords support to five and twelve tetrastichals (3 St.) respectively. Of the distichals (2 St.) just mentioned, the first ($2\ St_1$), fourth ($2\ St_4$), sixth ($2\ St_6$), eighth ($2\ St_8$), and tenth ($2\ St_{10}$), retain portions of pinnules attached, and so with the first tetrastichal ($3\ St_1$), and the third ($3\ St_3$). At the twelfth tetrastichal ($3\ St_{12}$) of the right branch is a cluster of pinnules, and beyond other detached ossicles, apparently of this same series, which would seem to indicate that the tetrastichals were very numerous, unless there be a tetraxil (3 Ax) hidden in the cluster of pinnules before mentioned. In the right-hand arm (i) of this fourth ray there are fourteen distichals (2 St.) preserved, and a cavity left by the disappearance of $2\ St_2$, thus again rendering the fifteenth distaxil (2 Ax). Beyond this, the tetrastichals (3 St.) on the left are indistinctly preserved, but on the right there are ten. Of the fifth ray, the ossicles are much displayed, and do not afford details for satisfactory description.

It becomes apparent that in the proximal portions of the arms, whether the ossicles be primibrachs or monostichals, the thirteenth is always the primaxil (I ax) or monaxil (1 Ax) as the case may be, and that in the next divisions, whether secundibrachs (II Br) or distichals (2 St), the fifteenth ossicle forms the secundaxil (II ax) or distaxil (2 Ax) as the case may be.

The presence of pinnules on the arms of one ray, and not on those of another has caused me to use the double terminology in describing the arm divisions. I take it this is the meaning of the following passage in Mr. Bather's previously quoted suggestive paper —"In cases where some only of the free brachial series bear pinnules,

it would be well to apply the Latin terminology to those brachials without pinnules, whether free or fixed, and the Greek to those with pinnules."*

The first primibrach (I Br_1) or first monostichal (1 St_1) are widely V-shaped along their ventral edges, and the dorsal edges of I Br_2 and 1 St_2 are correspondingly so.

Mr. Sweet's second specimen I take to be the long terminal portions of three arms, two united by an axil, but the third separate. In the former case there are fifty-four small ossicles in one branch and thirty in the other, both series being clearly incomplete; below the axil are indications of four ossicles. In the third instance there are about twenty ossicles above an axil, and below the latter eight. There is no trace of pinnules on either of the branches. If these are the actual terminal portions of arms they must be known as finials (F). What the ossicles below the axils are, whether secundibrachs (II Br), or tertiobrachs (III Br), it is of course impossible to say with certainty, but from the smaller size of the ossicles below the axils, as compared with those of the tertiary series in the larger specimen, they may be quartibrachs (IV Br). The long series of ossicles above would then become quintibrachs (V Br), or finials (F).

Consideration of the measurements of these various parts leads to the belief that Moore's estimate of the length of an arm, six inches, is much too little. It was certainly eight inches, but as none of the arms are absolutely complete, a still further extension must, I think, be allowed for. Each arm in *I. australis* is divided at *least seven* times, or fourteen divisions to the ray, giving for the five arms, a total of seventy divisions, presuming all to have been normally developed; probably there were more.

As in some Pentacrinidæ, and most Comatulæ, the second plates above the first radials are axillary, and in common with the intermediate plates are of the same width as the first radials.

It is curious that throughout the matrix of both Mr. Sweet's specimens, columnals are conspicuous by their absence. Such was also the case with Moore's, although he says that "in a block from Wollumbilla, a portion of a column, with ninety-five regular joints is present of probably the same species"—*i.e.* of *I. australis*. One of his figures exhibits the base of the calyx, "with its columnar articulation." The facet here displayed has unmistakable petaloid sectors.

The late Sir F. McCoy also, many years ago, when reporting on a collection of fossils from Wollumbilla for the late Rev. W. B. Clarke, recognised the columnals of a Pentacrinid amongst the specimens. He said,† "*Pentacrinus* of the true type having the petaloid arrangement of the articulating ridges, distinguishing the Mesozoic and Cainozoic Pentacrinites from the pentagonal crinoid stems of the Palæozoic periods."

As to the genus, Mr. Bather has shown that *Pentacrinus sensu-strictu*, possesses linear sectors on the columnal articular facets;

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* Ann. Mag. Nat. Hist., 1892, ix. (6), p. 60.

† Trans. R. Soc. Vict., 1865, vi., p. 44; Clarke's Recent Geol. Obs. in Australasia, 1861, p. 50.

infra-basals present in the adult condition; radials prolonged downwards over the proximal columnals, and cirri elliptical or compressed.* On the other hand he defines *Isocrinus* as with broad petaloid sectors on the columnal joints; radials not prolonged downwards; arms isotomous; two brachials below the first forking in a ray, and these without pinnules; and the cirri transversely elliptical or circular. So far as the characters of the present specimens can be made out, they accord better with the latter than the former, and on these grounds I have referred them to *Isocrinus*.

Loc. and Horizon.—Maranoa River—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

ANNELIDA.

Genus Serpula, *Linnæus*, 1753.

(Systema Nat., Ed. 10, p. 786.)

Serpula trachinus, *Goldfuss*?

(Pl. IV., figs. 5 and 6.)

S. trachinus, Goldfuss, Petrefacta Germaniæ, Zweite Aufl., 1862, Thiel 1, p. 219, Atlas t. 70, f. 1.

Sp. Char.—Tube long, smooth, convex on the sides, attenuated, slightly carinate and uncinate posteriorly, sometimes irregularly curved, never coiled spirally or in the same plane, or completely returned on itself, the slight posterior carina fading off anteriorly into an almost imperceptible obtuse angularity; no regular varices, but an occasional obtuse ring-like swelling of the test.

Obs.—I am unable to distinguish any points of difference between the Queensland fossils and that figured by Goldfuss as a Cretaceous species, except that the former are slightly less carinate posteriorly. None of the specimens show any sign of attachment, but are all lying free in the matrix—a dark blue impure limestone.

In advance of the posterior carina the middle line of the tube is in nearly every case depressed, as if a line of weakness existed, but not partaking of the nature of a groove.

The shell structure is preserved, and is similar to that of other Tubicolar Annelids, consisting of an inner minutely vesicular layer, a middle dense laminated layer, and an outer laminated and tubular layer.

Similar tubes from the Quader of Saxony known as *Serpula amphisbæna*, Goldfuss, common also to the Cretaceous of Britain, have been referred by Dr. A. E. von Reuss to the molluscan genus *Gastrochæna*,† and had it not been for the test structure of the present specimens I should have hesitated in the course now adopted with the latter. Some doubt still lingers in my mind from the fact that the Queensland examples are, unlike most *Serpulæ*, all free, unaglomerated, and unattached; nor, on the other hand, is there any evidence

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* Lancaster's Treatise, Pt. iii., Echinc., 1900, p. 182.

† Palaeontographica, xx., Theil 2, Lief. 6, p. 235, t. 52, f. 8-12.

remaining of the cyst-like proximal termination of the shelly tube as in *Gastrochæna*. Under these circumstances, and pending the acquisition of additional facts, the specimens are catalogued as above.

Loc. and Horizon.—Maranoa River and Wollumbilla—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

CRUSTACEA.

Only two crustaceans are known from the Australian Cretaceous with any certainty, although Mr. Charles Moore referred to certain obscure organisms from the Wollumbilla beds, that were, perhaps, the remains of Cirripedes.* The first of those referred to above is *Prosopon Etheridgei*, H. Woodward,† a Brachyurous Decapod, allied to species from the Neocomian rocks of the Department Jura, France. The nature of the matrix induces me to believe that the specimen came from the Central Queensland Cretaceous area.

The second specimen was referred to by myself in a short note accompanying Dr. Woodward's paper.‡ It is a portion of one of the large chelæ of a Macrurous Decapod, and it is preserved in a blue-grey concretionary limestone, much resembling that of the Walsh River District, and therefore from the same division of the Queensland Cretaceous as *P. Etheridgei*. It is impossible to name this specimen, but it may be compared to the corresponding part in *Palæastacus*, —*e.g.*, *P. Edwardsi*, Etallon.§ and *P. solitarius*, Oppell,‖—or *Eryma*, *Callianassa*, or *Schluteria*,—*e.g.*, *S. tetracheles*, Fr.‖ The specimen consists of the sixth joint or propodos, with the apical prolongation broken off, a portion of the dactylos, the carpos, and part of the meros.

Collection.—Queensland Museum.

NATIONAL MUSEUM MELBOURNE

POLYZOA.

Genus Lunulites, *Lamarck*, 1816.

(Hist. Nat. Anim. sans Vertèb., 1816, ii., p. 194.)

Lunulites abnormalis, *sp. nov.*

(Pl. IV., figs. 7 and 8.)

Sp. Char.—Zooarium circular, sub-cupuliform or inclined to infundibuliform, with a flattened or somewhat everted peripheral area. Zoœcia oblong, averaging half a millimetre in length. On the reverse the diverging rays or ribs, corresponding to the lines of zoœcia, are rounded, separated by impressed and distinct furrows, and the rays pierced by unequally distributed punctures, perhaps indicating the presence of anchoring processes, or stolons, now removed.

Obs.—The testiferous portions have almost entirely disappeared, leaving the organism represented by internal casts of the obverse and decorticated surfaces of the reverse. The casts of the zoœcia on the

* Quart. Journ. Geol. Soc., 1870, xxvi., p. 243.

† Proc. Linn. Soc. N. S. Wales, 1892, vii. (2), p. 301, t. 4.

‡ *Ibid*, p. 305.

§ Oppell, Pal. Mittheil. Mus. K. Bayer Staates, t. 11, f. 3a and *b*.

‖ Fritsch and Kafka, Crust. Böhm. Kreideform, 1887, t. 6.

obverse are oblong and follow one another in regular serial order. They are augmented by the interpolation of new lines of zoœcia between two pre-existing ones. The reverse is seen under three conditions—(1) Either as a series of sub-parallel, or slightly radiating continuous grooves, from which the whole of the zoœcia casts have been removed; (2) or, when seen from their outer side, as riblets, devoid of testaceous material, and punctate, as above described; (3) or, with traces here and there of the test remaining and supporting irregularly distributed wart-like papillæ, possibly the bases of anchoring stolons.

The zooarium, although circular, is not strictly cupuliform, but on the obverse or zoœcious face the margin is bent outwards, forming a flattened peripheral area. It furthers differs from that of *Lunulites* in that the obverse face bearing the zoœcia is the more or less concave aspect instead of being the convex as in the genus named. Again the Lunulites in the mature state are free, but fixed in youth; if, therefore, the perforations or wart-like papillæ indicate the former presence of anchoring filaments we see a further departure from the structure of *Lunulites*, for the present specimens certainly seem to be mature. The reference to *Lunulites* can only be regarded as provisional.

Loc. and Horizon.—Bungeworgorai Creek, near Mount Abundance—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

BRACHIOPODA.

Genus Lingula, *Bruguière*, 1791.

(Encycl. Method., i., pl. 250.)

Lingula subovalis, *Davidson.*

L. subovalis, Dav., Mon. Brit. Foss. Brach., i. Pt. 2, Cretaceous, No. 1, 1852, p. 7, t. 1, f. 29-30.

L. ovalis, Moore (*non* Sby.), Quart. Journ. Geol. Soc., 1870, xxvi., pp. 236 and 240.

L. ovalis, Eth. fil., Geol. Pal. Q'Land., &c., 1892, p., 444, t. 20. f. 14.

L. subovalis, Tate, Proc. Austr. Assoc. Adv. Sci. for 1888 (1889), i. p. 230.

Obs.—In reviewing the Queensland Mesozoic Brachiopoda, Mr. Moore remarked:—"The only species to be recognised (in the Wollumbilla blocks) is the *Lingula ovalis* of the Kimmeridge Clay, or the *L. subovalis* of the Lower Greensand, which names probably refer to the same species." In his list he afterwards speaks of it as *L. ovalis*, and under this name I subsequently quoted it. Professor Ralph Tate, however, has suggested that the species is really the *L. subovalis* of the L. Greensand, and I now think he is correct, although no interiors have been examined so as to place the question beyond doubt.

The form is that of *L. subovalis*, but the sculpture, consisting of microscopic close concentric threads, resembles that of *L. ovalis*.

Loc. and Horizon.—Wollumbilla—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

PELECYPODA.

Genus Pecten, *Müller*, 1776.*

(Zool. Danicæ Prod., p. 248.)

Pecten socialis, *Moore.*

P. socialis, Moore, Quart. Journ. Geol. Soc., 1870, xxvi., p. 248, t. 11, f. 10.

? *P. psila*, Ten. Woods, Proc. Linn. Soc. N. S. Wales, 1883, viii., p. 239.

P. socialis, Eth. fil., Geol. Pal. Q'land, &c., 1892, p. 446, t. 21, f. 6, 7, and 9.

P. sp. ind., Eth. fil., *Ibid*, t. 21, f. 5.

P. æquilineatus, Eth. fil., *Ibid*, t. 21, f. 8 (*non* p. 445).

Sp. Char.—Shell small, suborbicular, moderately convex, both valves practically alike; dorsal margin less than the width of the shell, shortest on the anterior side. Umbones very small, but pointed. Posterior auricles small, triangular, flattened, outer margin straight or slightly obliquely truncated; anterior auricles larger, elongately triangular, the outer margin obliquely rounded in the right valve, with a slight byssal sinus beneath, straight and truncate in the left valve. Sculpture on the body of the valves consists of a few concentric laminæ, particularly on the umbonal regions, but at times extending down the valves for a variable distance, with rounded, slightly irregular, curved or divaricating faint costæ that occasionally bifurcate; the anterior ears appear to bear two or three radii. Maximum size, about one inch long.

Obs.—This is essentially a very variable shell, and hence difficult of determination. Moore's figure, that of a left valve, is a decorticated example, and represents the condition in which it is often met with.

In the "Geology and Palæontology of Queensland, &c.," I referred to the late Rev. Mr. Tenison Wood's suggestion that his *Pecten psila* might be the young of Moore's *P. socialis*, and to the adoption of this view by Professor R. Tate,† with the following remark:—"But if the ears of Wood's species are, as he describes them, radiately ribbed, the two shells cannot be identical." At the time this was written I was ignorant of the whereabouts of Wood's type, but have since had the advantage of studying it. It is a piece of mudstone with a few miserably preserved examples of a very small *Pecten*, but the anterior ears certainly do bear two or three radii. I have now seen similar costæ on the anterior ears of *P. socialis*, and I can come to no other conclusion than that the two forms are identical, allowing for the poor condition of Wood's types. I am the more inclined to this view because the latter exhibit faintly, under the lens, the same fine divaricating striæ as on most examples of *P. socialis*, a point that seems to have escaped Wood's notice.

Moore figured a worn left valve. In my former work I gave several figures referred with hesitation to both *P. socialis*, *P. psila*, and *P. æquilineatus*, but after an examination of a number of examples from

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* Emended Lamarck, 1799.

† Geol. and Pal. Q'land, &c., 1892, p. 446.

Mr. Sweet's cabinet and a re-examination of Dr. R. L. Jack's original specimens, I have arrived at the conclusion that they must be all placed under *P. socialis* as individuals of one variable species.

In the youngest state there is no sculpture apparent.* In Fig. 7 of the work quoted below both the radiate and concentric ornament is visible through the shell; whilst in Fig. 9 the radiate alone is seen. The concentric rugation more or less disappears with age.

The presence and strength of the costæ entirely depend on the state of preservation. In examples retaining the outer shelly layer the costæ appear as somewhat divaricating depressed riblets, bifurcating now and then near the margins, and separated by valleys of less width than the riblets. On the other hand, decorticated specimens only show fine micro-costæ of a similar nature, but when exfoliation of the shelly layers has been carried still further, the surface exhibits only a streaky appearance, from a breaking up of the component laminæ.

The concentric rugæ are very variable in number, but always regular, and disappear more or less with age. They are sometimes confined to the umbonal region only, at others extending downwards for half the length of the valves, and in extreme cases for two-thirds.†

P. socialis is not a true *Pecten* in the restricted sense of the genus. The outline and character of the auricles point to *Pseudamusium*, Klein, or *Syncyclonema*, Meek, which Stoliczka‡ and Dall§ consider to be synonymous with one another; whilst Verrill,‖ on the other hand, retains them as separate genera. I am inclined to place this little shell in *Syncyclonema*, Meek¶. The condition of the costæ reminds us of *Camptonectes*, Ag., but there is no trace of the intercostal pitting, or "camptonectes sculpture."

The Rev. Mr. Tenison Woods, speaking of *Pecten psila*, says: "The fossil I have described might well be a young state of Mr. Moore's fossil. It is much smaller; the average dimension from hinge to margin is about 6 millimetres, with a transverse diameter of 5. It is found abundantly scattered over some fragments** of olive greenish marl, looking not unlike *Nummulites*. As I have only seen the figures and descriptions of *P. socialis*, and as the details are very imperfect, I think it better not to make too hasty an identification, but point out the resemblance for future inquiry."††

Loc. and Horizon.—Mitchell, Maranoa River, and Wollumbilla —Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

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* Geol. and Pal. Q'land, &c., 1892, t. 21, f 5.

† In my former description I described the anterior ears as smaller than the posterior, but the opposite should have been the case.

‡ Pal. Indica—Cretaceous Fauna, S. India, 1871, iii., Pts. 9-13, p. 426.

§ Bull. Mus. Comp. Zoology Harvard, 1885-6, xii., No. 5, p. 219.

‖ Trans. Connecticut Acad. Sci. Arts, 1899, x., Pt. 1, pp. 60 and 62.

¶ Smithsonian Miscel. Collections, 1864, xii., No. 177, p. 31.

** Only one piece has come under my notice.

†† Proc. Linn. Soc. N. S. Wales, 1883, viii., Pt. 2, p. 240.

Genus Maccoyella, *Eth. fil.*, 1892.

(Geol. Pal. Q'land, &c., 1892, p. 451.)

Obs.—This genus was proposed and described in 1892 to receive certain Australian Cretaceous bivalves, variously termed *Avicula* by Moore and *Monotis* by McCoy and Tate, but possessing no characters of importance in common with either. The number of species referable to *Maccoyella* is at present doubtful, but there are certainly three well established forms, in all probability an equally stable fourth, and several other fossils that it will be very difficult to place elsewhere, if not in this genus.

It is not my intention on this occasion to recapitulate the general characters of *Maccoyella*, but to confine my remarks simply to the hinge structure. The kindness of several acquaintances during the past few years, notably Dr. R. L. Jack, Mr. G. Sweet, Prof. R. Tate, and Prof. T. W. E. David, by the loan of specimens, has enabled me to restudy the morphology of this highly interesting genus, and so in some instances to modify my former views, and in others to amplify them.

The cardinal area in the united valves is equal to about two-thirds the breath of the latter, and is nearly always shorter on the anterior than the posterior side. It will be most advantageous to describe the hinge mechanism of the left or convex valve first. Beneath the slightly overhanging umbo, the area is continued across the umbonal cavity as a rather wide shelly ledge. The chondrophore, which occupies a very considerable proportion of this shelly ledge is divisible into two very unequal portions. Immediately posterior to the apex of the umbo is an obliquely elongate pyriform concavity, extending the whole width of the area, the anterior boundary of this portion of the chondrophore forming a prominent ridge or fold, also extending completely across the area diagonally to the umbo. Anterior to this pyriform scar and fold, and extending transversely across the upper part of the area is the second portion of the chondrophore, which is divided off from the scobinate lamellæ of the anterior end by a groove more or less deeply impressed, according to the species; for the sake of distinction in specific description these halves may be spoken of as the pyriform and transverse chondrophores respectively. Posterior to the former the area is continued as a narrow, linear, inwardly-bevelled margin to its junction with the rounded margin of the posterior end. Both portions of the chondrophore and the posterior area bear fine ligamental grooves, concentric in the pyriform scar, and parallel to the longer diameter in the transverse; anteriorly they are continuous with, and merge into the scobinate lamellæ. Beneath the posterior end of the transverse chondrophore, and alongside the anterior boundary of the pyriform scar, is a shoehorn-shaped socket, deep or shallow according to species, with its anterior ventral angle protruding as a strong, shelly projection, the homologue of a cardinal tooth, and beyond this still in an anterior direction, the shelly edge retires upwards, leaving a well-marked socket-concavity. Beneath the transverse shelly ledge of the area supporting this mechanism, and in the umbonal cavity is a more or less deep hepatic fossa.

In the right or flattened valve, the area is straight on the posterior side, and obliquely inclined to the very insignificant umbo anteriorly, but, as in the left valve, is thickened centrally, and obliquely bevelled inwardly as a whole. Immediately interior and slightly anterior to this umbo the area is inflected or folded on itself to form a very conspicuous plug or button (chondrophoral button), leaving beneath it, on its anterior side, a deep, narrow, and obliquely directed byssal sinus; from this point to the termination of the valve on the anterior side the hinge margin is sharp and unbevelled. On the posterior side of the chondrophoral button occurs a spoon-shaped or pyriform chondrophore, like and similarly marked, and opposite to that of the left valve; thence to the end of the valve the area is linear, and resembles that of the latter. The upper and outer portion of the chondrophoral button is somewhat flattened, and bears resilium furrows; inwardly these disappear, and its surface becomes hollowed or concave, the concavity narrowing inwards, and in fact forming a socket, as will be explained later on. The sides of this button project inwards as two obtusely pointed dental processes, homologous with teeth of other shells, for they perform precisely the same function. The anterior of the two is at the inward termination of the byssal sinus, the posterior forms a ridge between the button proper and the chondrophore, and at times is extended obliquely into a kind of ossiculum, beneath which is a transversely elongated hepatic fossa.

The adaption of these several parts of the two valves to one another is as follows:—The cardinal tooth-homologue of the left valve fits into the socket of the chondrophoral button, whilst the posterior dental process of the right valve drops into the shoehorn-shaped socket of the left valve. The anterior dental process of the chondrophoral button adjusts itself to the anterior concavity of the area of the left valve. By this means a lateral locking of the valves takes place, for to all intents and purposes these prominences and depressions of the hinge act the part of teeth and sockets and assist in retaining the valves in apposition.

The main portion of the resilium occupying the gap between the two pyriform scars was large and powerful, and so was that between the transverse scar of the left valve and the outer portion of the chondrophoral button, but the resilium lying between the inwardly bevelled posterior areas was of much less importance.

The depression, or pit I have termed the hepatic fossa, is present in all the species of which I have seen the interior, both right and left valves, and varies only in size and depth.

Maccoyella umbonalis, *Moore*, sp.

Avicula umbonalis, Moore, Quart. Journ. Geol. Soc., 1870, xxvi., p. 246, t. 12, f. 2 and 3.

Maccoyella umbonalis, Eth. fil., Geol. and Pal. Q'land, &c., 1892, p. 458, t. 22, f. 6 and 7, t. 23, f. 4.

Obs.—I have already stated all I know of this shell, or what I suppose to represent Moore's species. His description was meagre, and figures unsatisfactory for purposes of identification. The description already given may be advantageously emended by stating that the

umbo of the left valve is "produced," instead of "much produced"; and the anterior dorsal margin "crenulated," instead of "much crenulated."

M. umbonalis is one of the least satisfactory species of the genus, but as I have had before me at various times large shells that cannot be satisfactorily referred to either *M. Barklyi* or *M. reflecta*, I have provisionally included them in *M. umbonalis*, covered by the description already mentioned. Such specimens do not show so sub-lobate a posterior wing on the left valve as in *M. reflecta*, and the large umbo of the same valve is practically central. The cartilage area of the right valve, admirably shown in a specimen of Mr. Sweet's from Bungeworgorai Creek, is deeper and more massive than in either of the two species named. This particular valve measures five and a-half inches in height by six inches in breadth; in all probability *M. umbonalis* is the largest species of the genus.

The cardinal area in *M. umbonalis* is deep in both valves, and equal in length on both sides of the umbones. The umbo of the left valve rather overhangs its cardinal area, and the anterior cardinal tooth is massive. The shoehorn-shaped socket is wide, and the pyriform chondrophore deep and long. In the right valve the hinge mechanism is strongly developed, the dental processes of the chondrophoral plug being large, and the ossiculum of the posterior strong and pronounced. The socket for the reception of the anterior cardinal tooth of the left valve is wide, and the pyriform chondrophore deep and long. The byssal sinus is also well marked, but the chondrophore itself is not so prominent as in *M. Barklyi* or *M. reflecta*.

The adductor impression of full grown specimens is nearly round and subcentral, with a raised rim, particularly on its posterior side, and is about the size of a half-crown piece of money.

The row of muscle attachment pits uniting the hepatic fossa with the adductor impression are absent in the right valve of this species. The hepatic fossa itself is shallow.

The costæ are much more uniform in size than in either *M. Barklyi* or *M. reflecta*, and seem to be confined to primary and secondary.

Loc. and Horizon.—Bungeworgorai Creek, near Mount Abundance —Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

Maccoyella corbiensis, *Moore, sp.*

Avicula corbiensis, Moore, Quart. Journ. Geol. Soc., 1870, xxvi., p. 246, t. 11, f. 7.

Crenatula gibbosa, Eth., *Ibid.* 1872, xxviii., p. 339, t. 19, f. 3.

Avicula Barklyi, Ten. Woods, Proc. Linn. Soc. N. S. Wales, 1883, viii, Pt. 2, p. 240, t. 12, f. 6 (excl. f. 4 and 5).

Maccoyella corbiensis, Eth. fil., Geol. and Pal. Q'land, &c., 1892, p. 458, t. 22, f. 8 and 9.

Sp. Char.—Shell longitudinally ovate, longer than wide, somewhat deltoid and produced postero-ventrally. *Left valve* very convex, the

posterior cardinal area straight and narrow, with numerous fine resilium furrows; anterior cardinal tooth large proportionately, extending beyond the lower edge of the cardinal area; pyriform chondrophore transversly elongate but not deep, its fold often obsolete, and the shoehorn-shaped socket ill-defined or absent; umbo incurved, the apex acute and slightly recurved towards the anterior, with a deep, hollow and pronounced umbonal cavity; anterior margin of the valve oblique above and rounded medianally and below; scobinate foldings numerous but not strongly marked. Posterior end produced ventrally, semi-truncate, with a short, small, slightly convex and emarginate wing, sharply defined from the body of the shell. Ventral margin broadly rounded. Adductor impression subcentral and subcircular, concentrically ridged; pallial impression defined by a series of interrupted and impressed fibre scars. *Right valve* more or less concave; anterior and ventral margins rounded; posterior end slightly alate and rather produced postero-ventrally; umbo insignificant; chondrophoral button large, prominent, and triangular; byssal sinus narrow and channel-like. Sculpture of the left valve consisting of from eighteen to twenty simple radiating primary costæ, alternating with a similar number of finer secondary costæ, that barely reach the umbo, crossed by fine concentric frills, which echinate the costæ but do not rise into spines; the wing is apparently devoid of radii; there are in addition from three to five very conspicuous laminæ of growth on this valve. In the right valve the costæ are numerous, but less strongly developed than those on the left, the secondaries extending but a comparatively short distance up the valve.

Obs.—At the time my former description of this species was written, I had not had the advantage of examining anything like perfect specimens, and in consequence some of the characters then given require modification in the face of more perfect material since acquired. I have now seen the right valve in two New South Wales specimens, and although in both cases more or less crushed into the hollow of the left, it is still quite clear that this valve possessed some degree of concavity when in the natural state, and was neither flat nor convex.

The dorsal margin of the left valve is not arched in the typical form of the species, but straight; the arched condition mentioned in my former description arising from the use of much weathered examples in which the wings had been removed. This point should be carefully noted, for I find such a condition of the left valve a by no means uncommon one.

I am now convinced that the impression of a left valve from Maryborough, tentatively figured by me as *M. corbiensis*,* is so, and we must, therefore, accept this as another species occurring in both divisions of our Cretaceous Series.

Again, it is quite clear that one of the shells figured by the Rev. Mr. Tenison Woods as *M. Barklyi*, from the Grey Ranges, N.W. New South Wales, must be referred to *M. corbiensis;* neither will it

* Geol. Pal. Q'land, &c., 1892, p. 459, t.22, f.9.

surprise me to find that the shell figured by Moore as *Pecten fimbriatus*, from Wollumbilla, is nothing more than a left valve of this species minus the wing, &c. It is the type of my *Pecten Moorei*.

Loc and Horizon.—Bungeworgorai Creek, near Mount Abundance—Rolling Downs Formation (Lower Cretaceous); Corporation Quarry, Maryborough—Desert Sandstone (Upper Cretaceous).

Collection.—Sweet.

Maccoyella substriata, *Moore*, sp.

(Pl. III., fig. 5; Pl. IV., fig. 4.)

Avicula substriata, Moore, Quart. Journ. Geol. Soc., 1870, xxvi., p. 247, t. 11, f. 6.

Maccoyella? substriata, Eth. fil., Geol. Pal. Q'land, &c. 1892, p. 459, t. 22, f. 10 (*non* t. 23, f. 8 and 9).

Maccoyella? subangularis, Eth. fil., *Ibid.*, p. 460.

Obs.—I still believe I am correct in referring a specimen in Mr. Sweet's collection from Bungeworgorai Creek to this species, notwithstanding that it is much larger than that represented in Moore's figure; the fossil in question measures one inch long by one and a-quarter inches in width.

A cast from Maryborough cannot be separated from the previous specimen, and is even a trifle larger, measuring one inch long by one and three-quarter inches in width.

So far as I am acquainted with *M. substriata*, one of its chief specific points is the largely extended posterior wing, much larger in proportion to the size of the shell than in any other *Maccoyella*. The right valve is unknown to me.

Loc. and Horizon.—Bungeworgorai Creek, near Mount Abundance—Rolling Downs Formation (Lower Cretaceous); Corporation Quarry, Maryborough—Desert Sandstone Series (Upper Cretaceous).

Collection.—Sweet.

Maccoyella rostrata, *sp. nov.*

(Pl. IV., fig. 3).

Maccoyella substriata, Eth. fil., Geol. Pal. Q'land, &c., 1892, p. 564, t. 23, f. 8 and 9 (*non* t. 22, f. 10).

Sp. Char.—Shell of medium size. Left valve convex in the middle line, posteriorly very alate and extended; dorsal margin long on both sides the umbo, but particularly so on the posterior, curving upwards at its extremity, and in conjunction with the posterior margin forming a kind of rostrum, but on the anterior it is oblique; posterior end flattened and extended, the margin declining obliquely towards the ventral, which is rounded; two or three resilium furrows along the posterior dorsal margin; anterior end small, produced, the margin rounded; sculpture of twelve (? or a few more) primary costæ, which do not appear on the posterior end.

Obs.—I formerly referred two specimens, with doubt, to *M. substriata*, one having the dorsal margin on the posterior side gradually curving upwards to assist in forming a rostral prolongation. Since the period in question, another example has turned up in Mr. Sweet's

cabinet, from the same locality as the former specimens (Dr. R. L. Jack's), and again accompanied by its right valve. So far as the structure of *M. substriata* proper can be made out, there does not appear to be any tendency to form this rostral posterior dorsal end; possibly, on this account, there may be two species, otherwise closely allied, but this is only one of the many doubtful points that future collectives can clear up.

The right valve is very imperfectly known. I figured what I believed to be it,* and this opinion is supported by the fact that, in the more recently acquired example, a similar valve peeps out on the surface of the matrix from below the left valve. It exhibits numerous radiating costæ of the first order, with intermediate secondary radii, crossed by delicate concentric lines representing the frills of the larger species of the genus.

Loc. and Horizon.—Corporation Quarry, Maryborough—Desert Sandstone Series (Upper Cretaceous).

Collection.—Sweet.

Genus Pinna, *Linnæus*, 1758.

(Syst. Nat., 1758, Ed. x.)

Pinna australis, *Hudleston.*

P. australis, Hudleston, Geol. Mag., 1890, vii. (3), p. 244, t. 9, f. 6.

? *Pinna, sp. ind*, Eth. fil., Geol. Pal. Q'land, 1892, p. 465, t. 20, f. 16 and 17.

Obs.—Four specimens of a *Pinna* are in Mr. Sweet's collection. Three of these are in a very poor condition, but from Mr. Hudleston's description of the sculpture, I am led to believe that they may be referable to his species, at the same time I am not able to distinguish the curvilinear concentric lines described by him. These fragments are from the Upper Cretaceous of Maryborough. A fourth example, however, from the lower division of the series at Hughenden, leaves less room for doubt, for the curvilinear lines are there visible.

The straight plain costæ on the Maryborough specimens ally them with *Pinna calamitoides*, Shumard,† from the Cretaceous of Vancouver Island; and also *P. Lakesi*, White,‡ occurring in the Cretaceous rocks of North Colorado.

P. australis is believed by Mr. Hudleston to be intermediate between the cuneate and tetragonal species of the genus, but rather to approach more nearly *P. tetragona*, Sby.

On the whole I think it may be accepted that the Queensland Lower Cretaceous form is *P. australis*, with the possibility that the three portions from the Maryborough beds are so also.

Loc. and Horizon.—Hughenden—Rolling Downs Formation (Lower Cretaceous); ? Corporation Quarry, Maryborough—Desert Sandstone Series (Upper Cretaceous).

Collection.—Sweet.

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* Geol. and Pal. Q'land, &c., 1890, t. 23, f. 8.

† Whiteaves, Canadian Mesozoic Fossils, 1879, i., Pt. 2, t. 20, f. 1 *a* and *b*.

‡ Contributions to Pal., No. 2, 1880, t. 2, f. 1 *a* and *b*.

Genus Mytilus, *Linnæus*,* 1758.

(Syst. Nat. 758, Ed. x. i., p. 704.)

Mytilus palmerensis, *sp. nov.*

(Pl. II., fig. 9.)

Mytilus inflatus, Ten. Woods (*non* Moore), Journ. R. Soc. N. S. Wales for 1882 (1883), xvi., p. 153, t. 10, f. 11.

Mytilus inflatus (pars), Eth. fil., Geol. Pal. Q'land, &c., 1892, p. 467.

Sp. Char.—Shell large, irregularly rhomboidal, of graceful proportions; valves regularly rounded and convex, without prominent diagonal ridges, or marked posterior slopes. Cardinal margins short; escutcheon small and narrow. Anterior and ventral margins combined obliquely rounded, the anterior end completely closed; posterior margins non-truncate, but long and gently curved, forming with the ventral margins a very obtuse postero-ventral angle. Umbones quite terminal, obtuse, depressed, incurved, but hardly touching. Sculpture consisting of well-marked concentric fine and sharp laminar lines gathered into bundles at the anterior ends, with the interspaces slightly concave, and bearing numerous fine concentric striæ; the second shelly layer is microradiate.

Obs.—In my former description I placed this shell with a note of interrogation as a synonym of *Mytilus inflatus*, Moore,† remarking: "Mr. Tenison Wood's figure represents a still larger individual, and one posteriorly so much more lengthened than Moore's figure, that I would prefer for the present to withhold a conclusive opinion as to its identity." Mr. Woods stated that his specimen was double the size of Moore's species. Had he stated three times it would have been nearer the mark; it is two and three-quarter inches in longitudinal diameter. After the above remarks were written I received from Dr. R. L. Jack a second specimen, agreeing in every particular with Ten. Wood's type, and I am now of opinion that my former surmise of the specific dissimilarity of the Palmer River shell and Moore's *M. inflatus* was correct.

M. palmerensis besides being a larger shell than *M. inflatus* presents a greater expanse of shell surface in the same plane, and is without the marked umbonal slope of the latter; the escutcheon is likewise far smaller in proportion to the size of the valves.

Loc. and Horizon.—Fairlight, Upper Flinders River—Rolling Downs Formation (Lower Cretaceous). Wood's specimen came from the Palmer River, hence the specific name.

Collection.—Geological Survey of Queensland. (*Pres.* A. Thomson.)

Genus Inoceramus, *Parkinson*, 1819.

(Trans. Geol. Soc., 1819, v., p. 55.)

Obs.—*Inoceramus* is largely developed in the Lower Cretaceous of Queensland, particularly in the beds of the Flinders River, about Hughenden and Marathon, but is, so far, unknown in the Lower Cretaceous of Western New South Wales, and in the Upper

* The name *Mytilus* should give place to that of *Perna*, Adanson (*non* Brongniart).

† Quart. Journ. Geol. Soc., 1870, xxvi., p. 252, t. 13, f. 4.

NATIONAL MUSEUM MELBOURNE

Cretaceous (Desert Sandstone) of the Maryborough and Croydon areas. It however occurs in this latter series in the White Cliffs District of New South Wales. Only one example is known to me from South Australia, a gypseous cast in a very poor state of preservation, collected by Mr. H. Y. L. Brown.

The following species have been named or described from our Cretaceous rocks :—

Inoceramus Carsoni, *McCoy.*
„ Sutherlandi, *McCoy.*
„ problematicus, *Eth.*
„ marathonensis, *Eth.*
„ pernoides, *Eth.*
„ elongatus, *Eth.*
„ Cripsii, *Mantel.*
„ maximus, *Lumholtz.*

The two first were never described or figured by their author, although referred to by him in a comparative sense in two short papers. It would, unquestionably, have been an advantage to palæontological science had they been disregarded from the first, for the retention of these names has been the cause of confusion in attempts by others to determine the species; but having myself assisted to retain McCoy's names, it would now be illogical on my part to abandon them, unless this can be done strictly in accordance with the laws of nomenclature. At the time I wrote my portion of the work common to Dr. R. L. Jack and myself, I felt from this cause and the invariable poor state of the specimens, very undecided as to my identification of *I. Carsoni* and *I. Sutherlandi*, and their relation to the forms described by Mr. R. Etheridge, F.R.S. Since that time I have had, through the kindness of the late Sir F. McCoy, an opportunity of examining the original specimens used by him, and I find that my conclusions were just the opposite of what they should have been; in other words, the form I took to be *I. Carsoni* is *I. Sutherlandi*, and *vice versâ*. Furthermore, *I. pernoides*, Eth., is also *I. Carsoni*, but *I. marathonensis*, Eth., is, in all probability, a good species. There is now, however, a strictly justifiable method of abandoning the objectionable names, as will be shown below. *Inocaramus elongatus*, Eth., is, I am afraid, too imperfectly figured for future recognition. Of the form referred by me to *I. Cripsi*, I have no further information, but a new and well-marked species is introduced as *I. constrictus*.

Inoceramus Etheridgei, *nom. nov.*

I. Carsoni, McCoy, Ann. Mag. Nat. Hist., 1865, xvi. p. 334 (*neither description nor fig.*).

I. Carsoni, McCoy, Trans. R. Soc. Vict., 1866, vii., p. 50 (*neither description nor fig.*).

I. Carsoni, McCoy, Ann. Mag. Nat. Hist., 1867, xx., p. 196 (*neither description nor fig.*).

I. pernoides, Eth. (*non* Goldf.), Quart. Journ. Geol. Soc., 1872, xxviii., p. 343, t. 22, f. 3.

?. *I. problematicus*, Eth. (*non* D'Orb.), *Ibid*, p. 344, t. 22, f. 4.

I. Carsoni, Eth. fil., Geol. .Pal. Q'land, &c., 1892, p. 463 (*non* t. 25, f. 9 and 10).

I. pernoides, Eth. fil., *Ibid.*, p. 464, t. 25, f. 7, 8, and 12.

I. sp. ind., Eth. fil., *Ibid*, t. 21, f. 19.

Sp. Char.—Shell more or less mytiloid in outline, acuminating towards the umbones, convex, especially in the umbonal regions; test thick; hinge lines or cardinal margins straight, about half the length of the shell. Anterior ends, strictly speaking, wanting. Posterior wings small, not differentiated from the body of the shell except by a general flattening of the valves, the margins obliquely rounded. Ventral margins rather widely curved, swelling out towards the posterior, and gradually insinuated towards the umbones anteriorily. Umbones quite terminal and acute. Sculpture consisting of raised concentric lines, at irregular distances apart, sometimes grouped in bundles of two, three, or four, and reposing on wide flattened concentric folds.

Obs.—The above synonomy indicates that as Sir F. McCoy's name was in no instance accompanied either by a description or figure, that of Mr. Etheridge should, by the rules of nomenclature take precedence. It is, however, unfortunate that the name *pernoides* had, according to Bronn,* been previously thrice used in a specific sense—by Goldfuss, Portlock, and Matheron. The two first I have verified, but the third I have not seen; Portlock's shell is a Carboniferous species and a very doubtful *Inocaramus*. Under the circumstance, and with the view of avoiding this confusion, I propose for this fossil the name of *I. Etheridgei*, in honour of Mr. R. Etheridge, F.R.S.

I. Etheridgei may be distinguished from the other Australian species of the genus by its mytiloid outline, absence of an anterior end strictly speaking, and the well-defined nature of its sculpture. In the first of these characters, and the attenuated outline umbonally, *I. Etheridgei* closely resembles *I. lucifer*, Eichwald,† from the Cretaceous rocks of the Aluetian Islands, *I. simplex*, Stoliczka,‡ of the Indian Cretaceous, and *I. lingua*, Goldfuss.§ An alliance is more apparent with the smaller forms figured by D'Orbigny as *I. problematicus*‖ than with the elongated examples of the same species.¶

I. Etheridgei attains to several inches long, and is a massive species, with a test sometimes as much as a quarter of an inch thick.

Loc. and Horizon.—Marathon and Hughenden Stations—Rolling Downs Formation (Lower Cretaceous). (The three last localities given by me formerly should probably be attached to *I. maximus*, Lumholtz.)

Collection.—Sweet.

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* Index Pal., 1848, i., p. 612.

† Geogn. Pal. Bemerkungen Halbinsel Mangischlak u. d. Aleutischen Inseln, 1874, p. 194, t. 18, f. 5 and 6.

‡ Pal. Indica—Cretaceous Fauna of India, 1871, iii., Pts. 5-8, t. 28, f. 3, 4.

§ Petrefacta Germaniæ, Theil 2, t. 111, f. 5.

‖ Pal. Franç, Terr. Crét., iii., t. 406, f. 1-5.

¶ *Ibid.*, f. 6 and 7.

Inoceramus maximus, *Lumholtz.*

I. Sutherlandi, McCoy, Ann, Mag. Nat. Hist., 1865, xvi., p. 334 *(neither description nor fig.)*.

I. Sutherlandi, McCoy, Trans. R. Soc. Vict., 1866, vii., p. 50 *(neither description nor fig.)*.

I. Sutherlandi, McCoy. Ann. Mag. Nat. Hist., 1867, xx., p. 196 *(neither description nor fig.)*.

I. Carsoni, Eth. fil., Geol. Pal. Q'land, &c., 1892, t. 25, f. 8, 9, and 12 (*excl. Obs.*, &c.)

I. Sutherlandi, Eth. fil., *Ibid.*, p. 163 (*excl. two last localities.*)

Inoceramus, sp. ind., Lundgren, Bihang K. Svenska Vet.-Akad. Handl., 1886, xi., No. 5, p. 4, pl.

I. maximus, Lumholtz, Among Cannibals, 1890, p. 367, fig.

Sp. Char.—Shell attaining a large size; sub-triangular or irregularly rhomboidal, most convex somewhat nearer the ventral than the dorsal margin; test thick. Hinge lines or cardinal margins moderately long, but not equal to the length of the shell. No anterior ends strictly speaking in front of the umbones, but from the beaks downwards the margins are oblique; posterior ends more or less flattened, the margins obliquely truncated and the postero-dorsal angles well rounded. Umbones quite terminal, obtuse. Sculpture consists of laminæ of growth, coarse and somewhat rugged on and a short distance below the umbones, but widening out towards the posterior.

Obs.—For reasons similar to those given under *I. pernoides*, the name *I. maximus*, Lumholtz, must take precedence over that given by McCoy.

This is certainly the largest Australian *Inoceramus* but one, specimens reaching to nine inches long.

In one of the best preserved examples the umbones are widely separated by a space for the reception of an inordinately large cartilage, the surface of the area at the spot in question being gently crenulated, but without pits.

Amongst Mr. Sweet's specimens is the remains of a very large individual, that from its imperfection cannot be specifically determined. When perfect it must have been over one foot long, and is apparently a curved and flattened form. The hinge line seems to be very short, rounding off into the obliquely curved posterior margin. Whether an enlarged form of the present species, or distinct, it is impossible to say, but probably the latter. It is from Marathon.

A large specimen of *I. maximus* in the Geological Survey of Queensland collection, from Hughenden, is eight and a-half inches long by six inches wide, and four inches through the united valves.

Loc. and Horizon.—Hughenden and Marathon Stations—Rolling Downs Formation (Lower Cretaceous).

Collections.—Sweet; and Geological Survey of Queensland.

Inoceramus constrictus, *sp. nov.*

(Pl. II., fig. 7; Pl. III., fig. 6.)

Sp. Char.—Shell irregularly quadrate; valves moderately convex flattened posteriorly, sulcate anteriorly. Hinge lines or cardina margins straight, not extending the entire width of the shell; area

narrow, with wide and shallow resilifers. Anterior ends convex or bourrelet-like, divided off from the body of the shell by cinctures of variable width and depth, extending from just anterior to the umbones to the ventral margins; posterior ends sub-alate, the margins sub-truncate and oblique above, and without emargination, rounded below. Greatest convexity of the valves immediately posterior to the cinctures, and in a vertical line with the umbones, which are small and not incurved. Sculpture consisting of numerous concentric corrugations, which, with interpolated finer lines, are deflected upwards at the cinctures, and individually have a rolling or wavy course across the valves; on the posterior ends the corrugations become laminar and sub-imbricate.

Obs.—This form appears to be one of the best marked amongst the Australian species of *Inoceramus*, and may be distinguished by the anterior cinctures. When the latter are at all deep, the anterior ends become bourrelet-like. In one specimen from the Geological Survey of Queensland collection there is a very small anterior ear visible immediately at the termination of the hinge line. The majority of the specimens average about two and a-half inches, but it has been noted up to four and a-half inches long.

Loc. and Horizon.—Hughenden and Marathon Stations; Flinders River, behind Hughenden Hotel—Rolling Downs Formation (Lower Cretaceous).

Collections—Sweet; and Geological Survey of Queensland (*Pres.* E. K. Ogg).

Genus Malletia, *Desmoulins*, 1832.
(Act. Soc. Lin. Bordeaux, 1832.)

MALLETIA RANDSI, *Eth. fil.*

Nuculana (?*Yoldia*) *Randsi*, Eth. fil., Geol. Pal. Q'land, &c., 1892, p. 566, t. 26, f. 10.

Sp. Char.—Shell large, transversely elongate and ovate, tumid in the umbonal region, rostrate posteriorly. Dorsal or cardinal margins slightly convex anteriorly, straight or somewhat concave posteriorly; ventral margins rounded, obliquely so posteriorly; anterior ends well developed, tumid, and produced, the margins rounded; posterior ends produced, rostrate, gradually compressed and somewhat tilted upwards, the extreme margins rounded. Umbones sub-central, tumid; beaks approximate; anterior slopes rounded, the posterior more flattened, no diagonal ridges strictly speaking; chondrophore absent; teeth numerous, about twenty on each side, decreasing rapidly in size on both sides towards the centre; escutcheon long and narrow; ligament opisthodetic, external, short; adductor scars faint; pallial line strongly marked, with a wide and deep sinus, and a long linear pallial tongue; sculpture fine and concentric.

Obs.—*Malletia Randsi* was originally described from an internal cast, and there are in Mr. Sweet's collection four examples in the same condition, all decidedly larger than the type, more tumid, and with proportionately longer posterior ends. The latter, through a more or less upward curvature of the cardinal margins, are to some extent rostrate. The type specimen was by no means perfect, and I now find that the illustration of it, although correct so far as it goes, by no means gives a correct idea of the shell.

Many of the Maryborough fossils, from their peculiar method of fossilation, become distorted and crushed, and it is possible that the present specimens may even exhibit too great a degree of timidity, judging by a few almost perfect examples that have come under my notice from the Lower Cretaceous in other collections. The Maryborough specimens conclusively prove that a choudrophore was absent, and that the teeth were continuous beneath the beaks; this at once eliminates from consideration my suggested reference to *Yoldia*. An example in Prof. R. Tate's collection from South Australia possesses a ligament, and another in the Sydney University collection, from Dunlop, is similarly provided. Prof. Tate referred his specimens to *Solenella* (= *Malletia*), a reference supported by the deep and wide pallial sinuses, seen on one of them. Other features said to be present in *Malletia* are not visible here, and an element of doubt must still exist in connection with the genus of this shell.

I am perplexed as to the relation of *M. Randsi* to *Leda elongata*, Eth. (*Adrana*, mihi.) The latter was evidently described from an imperfect fossil, but with certain details of restoration, the figure would undeniably come very near to the former. It entirely depends on the ultimate generic reference of *L. elongata*, whether or no the name will stand. If it be an *Adrana*—which I now much doubt—the name must go, for one of the Sowerbys has described a recent *Leda elongata*, the type of the genus *Adrana*, Adams.

I hope to throw more light on this question when dealing with the South Australian Cretaceous fossils.

Loc. and Horizon.—Maryborough—Desert Sandstone Series (Lower Cretaceous).

Collection.—Sweet.

Genus Solemya, *Lamarck*, 1818.

(Hist. Nat. Anim. sans Vertèb., 1818, v., p. 488.)

SOLEMYA CRETACEA, *sp. nov.*

(Pl. IV., fig. 2.)

Sp. Char.—Shell transversely elongate, moderately convex. Cardinal margins long and straight, ventral margins centrally straight. Anterior ends very long, convex, margins rounded; posterior ends short, margins rounded; posterior diagonal ridges obtusely rounded, and the posterior slopes somewhat flattened. Umbones very excentric; post-median sculpture of many (apparently twenty) acute radiating costæ, some of them arranged in pairs, separated by shallow valleys, with a few concentric laminæ, generally indistinct on the flanks of the valves, but more apparent on the posterior ends; a few very delicate concentric lines are also visible, but the valve surfaces are otherwise smooth and shining.

Obs.—In the absence of internal features it is difficult to seize upon external ones, other than the sculpture, of an essentially distinctive character. The sculpture and the form of the shell appear to be so typically those of *Solemya* that I do not hesitate to refer the fossil to that genus.

Very few species of Cretaceous *Solemyæ* appear to have been described. Stoliczka, at the time he wrote,* recorded only two, *Solemya subplicata*, Meek and Hayden, and *S. ventricosa*, Conrad, both American forms. To these must now be added *S. occidentalis*, Stanton,† from the Cretaceous of California, and *S. costata*, Tullberg,‡ a Nova Zembla species.

Solemya subplicata, M. and H.,§ is a small shell without posterior radiating costæ, and from *S. occidentalis*, Stanton, the Queensland shell is at once distinguished by its greater size and straight dorsal and ventral margins. *S. costata*, Tullberg, is a name applied to a fragment only.

Loc. and Horizon.—Walsh River—Rolling Downs Formation (Lower Cretaceous).

Collection.—Geological Survey of Queensland (*Pres.*, A. Brand).

Genus Tatella, *gen. nov.*

Gen. char.—Shell transversely elongated, more or less psammobiform, equivalve, subinequilateral, generally compressed, slightly oblique towards the anterior, which is frequently the longer of the two ends, both of which gape. Cardinal margins much thickened, particularly anteriorly, bearing two almost central cardinal teeth in the right valve, and one large similar tooth in the left valve, received between the two former; no lateral teeth. Ligament short and thick, anterior adductor impressions elongately pyriform and oblique; posterior adductor impressions round. Pallial line slightly sinuated, the sinus wide and very shallow. Sculpture concentric.

Obs.—In 1892 I published the type of this proposed genus as *Corbicella? maranoana*, not that it possessed any particular relation to that genus, but more from a fancied external resemblance, and an inability to place it elsewhere. The internal characters were, at that time, imperfectly known to me, but by means of further material I have succeeded in deciphering them moderately well. As I am still unable to locate the shell with any degree of confidence in any of the described genera, I am constrained to propose for it a new name, and in doing so find particular pleasure in associating with it the name of my good friend Prof. Ralph Tate. His services to Palæontology have already been acknowleged by the institution of the genus *Tatea*, Ten. Woods, but the variation to *Tatella* will be sufficient to distinguish the two.

I believe *Tatella* to be a member of the Psammobiidæ, having relations with both *Psammotæa*, Lamarck, and *Quenstedtia*, Morris, and Lycett. There is, however, one very marked difference between it and members of this family generally, except, perhaps, *Quenstedtia*—viz., the wide and shallow pallial sinus.

I cannot find any trace of lateral teeth. The cardinal of the left valve is large and blunt; those of the right valve abutting on each side of it are smaller, and are so placed as to almost form a fosette for its reception. In both valves the centre of the hinge-plate holding these teeth is supported by a strong although very short ossiculum.

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* Pal. Indica. Cret. Fauna S. India, 1871, iii, Nos. 5-8, p. 271.
† Bull. U.S. Geol. Survey (Walcott's), No. 133, 1898, p. 55, t. 10, f. 2 and 3.
‡ Vet.-Akad. Handlingar, 1880, vi, No. 3, p. 11, t. 1, f. 15 and 16.
§ Meek, U.S. Geol. Survey Report (Hayden's), 1876, ix, p. 129, t. 28, f. 19.

Internal casts differ much in appearance from testiferous specimens, the dissimilarity arising chiefly from the thickening of the anterior portion of the hinge-plate, which conveys to the cast an apparent uprising of the dorsal margin. The anterior ends are also in some instances the longer of the two extremities of the shell, which conveys to the latter a rather *Solemya*-like appearance. The anterior adductor impressions are peculiar both in position and shape, for they are immediately under the dorsal margins of the valves, sub-parallel to them, elongately-obliquely pyriform, and limited post-ventrally by shelly ridges which leave stronger impressions at those points. The posterior adductor impressions are oval, or nearly round, and are again close under the dorsal margins.

The pallial impressions are placed well within the ventral margins, short, well rounded, and devoid of pallial tongues,* the sinuses being broad and very shallow. The condition here seen very closely resembles the form of the sinuses in the genus *Cultellus*.

Like those of *Psammobia* and its allies, the valves in *Tatella* gaped at both ends, were more or less compressed, and with small and contiguous umbones. As in one genus (*Psammotea*) there is one cardinal tooth in the left and two in the right valve, interlocking and placed immediately below the umbones; furthermore, lateral teeth are absent. If *Quenstedtia* be correctly placed in the Psammobiidæ† there are further points of resemblance, such as the elongated anterior adductor impression, the oval posterior, and the very shallow pallial sinus.

I am not acquainted with *Tatella* other than in Australian Cretaceous rocks, and at present only one species is comprised within it, which forms the type.

Tatella maranoana, *Eth. fil.*

(Pl. I., fig. 5; Pl. II., fig. 8.)

Corbicella? maranoana, Eth. fil., Geol. Pal. Q'land, &c., 1892, p. 471, t. 27, f. 4 and 5; t. 28, f. 2 and 3.

Obs.—In addition to the characters given under the genus, which are equally those of the species, it may be added that the ventral margins of the valves are rounded, curving rapidly upwards to the obliquely sub-truncate posterior margins, the anterior ends being extended and rather pointed. The sculpture consists of irregularly spaced concentric laminæ, with intermediate finer lines, but no radii.

In two out of the three testiferous specimens I have seen the umbones were eroded.

The following measurements were noted:—In testiferous specimens—(1) two and one-eighth inches wide and one and one-sixteenth inches long; (2) two inches wide and one inch long. In casts—(1) one and a-half inches wide and three-quarters of an inch long: (2) one and three-quarter inches wide and thirteen-sixteenths of an inch long.

Loc. and Horizon.—Maranoa River, half-a-mile above Mitchell Railway Station—Rolling Downs Formation (Lower Cretaceous).

Collection.—Geological Survey of Queensland.

* Languette palléale (Fischer).

† Fischer, Man. Conchyl., 1887, p. 1106.

Genus Glycimeris (*Klein*), *Lamarck*, 1799.
(Mem. Soc. Hist. Nat. Paris, 1799, p. 83.)

GLYCIMERIS RUGOSA, *Moore*, *sp.*
(Pl. IV., fig. 1.)

Panopæa rugosa, Moore, Quart. Journ. Geol. Soc., 1870, xxvi., p. 253, t. 13, f. 7.

Panopæa sulcata, Etheridge, Quart. Journ. Geol. Soc. 1872, xxviii., p. 21, f. 2*a* (*non* f. 2.)

Myacites? australis, Hudleston, Geol. Mag., 1884, i., p. 340, t. 11, f. 9.

Glycimeris rugosa, Eth. fil., Geol. Pal. Q'land, &c., 1892, pp. 478 and 571, t. 28, f. 4 and 5.

Sp. Char.—Shell transversely ovate, anteriorly inflated, convex or tumid in the anterior region, but the amount of convexity variable. Dorsal or cardinal margins straight, rather less than the width of the shell (with raised ridges for attachment of the ligament, *Moore*); ventral margins very slightly rounded, or nearly straight. Anterior ends thick and broad, the margins rounded or sub-truncate; obtuse diagonal ridges are present, and the anterior slopes flattened. Posterior ends gradually attenuated laterally, gaping almost from the umbones along the dorsal margins; diagonal ridges rounded, and the posterior slopes inconspicuous; margins rounded, hardly at all reflected to form the gape. Umbones acute, approximate, and incurved slightly towards the anterior, much depressed or flattened from above; and in consequence of the presence of both anterior and posterior diagonal slopes, the umbonal region presents an isolated appearance. Anterior adductor impressions faint; the posterior well marked. Pallial sinuses deep and moderately wide. Sculpture, consisting of irregular rough concentric rugæ, stronger on the anterior ends, and with intermediate finer lines of growth, and an epidermal covering of anastomosing fibres; on the umbones the concentric rugæ are fine and very regular.

Obs.—*G. rugosa* may, on the whole, be described as a solid and heavy shell. On two specimens I have seen what seems to be a ligament; it was short and thick.

I have not been able to study the hinge structure of this species beyond ascertaining that a process existed in at least one of the valves.

The posterior gape of the valves is very apparent in all specimens that have passed through my hands, but an anterior gape is by no means so certain. It is seen in the figure* previously given by me, but, on the other hand, examples are in Mr. Sweet's cabinet in which the valves at the anterior end are most certainly closed. Whether or no this is only the result of a *post-mortem* relaxation of the ligament, and a consequent fore-and-aft rocking of the valves, whereby they have become closed at the anterior end, it is impossible to say, but it may be so.

Loc. and Horizon.—Maranoa River, near Mitchell, and Wollumbilla—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

* Geol. and Pal. Q'land, &c., 1892, t. 28, f. 5.

GLYCIMERIS MACCOYI, *Moore*, sp.

Panopœa Maccoyi, Moore, Quart. Journ. Geol. Soc., 1870, xxvi., p. 253, t. 13, f. 8.

Panopœa sulcata, Etheridge, *Ibid*, 1872, xxviii., p. 342, t. 21, f. 2, (*non* f 2*a*.)

Glycimeris Maccoyi, Eth. fil, Geol. Pal. Q'land., &c., 1892, p. 480.

Glycimeris sulcata, Eth. fil., *Ibid*, p. 571, (*non* t. 17, f. 18).

Sp. Char.—Shell transversely ovately-oblong, moderately large, tumid, almost equilateral, and gaping posteriorly. Dorsal or cardinal margins long, straight, and thickened internally; ligamentary fulcrum small; ventral margins slightly rounded, or almost straight. Anterior ends tumid, falling away rapidly to the margins, which are more or less truncate and squared; posterior ends tumid behind the umbones, rapidly thinning off towards the margins, which are rounded, but somewhat oblique above, gaping from the umbones, but not reflected. Umbones sub-central, more anterior than posterior, tumid, incurved, and moderately close, flattened from above; posterior slopes undefined. Posterior adductor impressions broadly or roundly pyriform. Sculpture consisting of wide-apart laminar rugæ, apparently to some extent dying off on the posterior ends, each lamina carrying finer lines of growth, and the whole at times much wrinkled.

Obs.—As I have already elsewhere observed, examples of *Glycimeris sulcata*, Eth., from the Upper Cretaceous are usually so crushed and often distorted that it is difficult to arrive at a clear conception of their characters, but two good casts in Mr. Sweet's collection, aided by a fairly well preserved example in that of Prof. R. Tate, with the test to some extent preserved, from the Lower Cretaceous, lead to the conclusion that one of Mr. Etheridge's figures must be regarded as identical with Moore's species. The other (f. 2*a*) seems to me to be *G. rugosa*, Moore.

The hinge structure is not that of a *Mya*, but approximates much closer to that of *Glycimeris*. In the best preserved of the casts just referred to, there appears to be evidence of a tooth, or process, in each valve fitting into sockets in the opposite respectively, but I have not been able to trace interrupted pallial lines, nor are the posterior adductor impressions elongated. I cannot satisfactorily determine an inequality in the valves, as suggested by Mr. Moore, and if the valves gape at the anterior end of the shell, it must be to a very slight extent.

Loc. and Horizon.—Corporation Quarry, Maryborough—Desert Sandstone Series (Upper Cretaceous).

Collection.—Sweet.

CEPHALOPODA.

Genus Haploceras, *Zittel*, 1870.

(Ceph. Stramberger Schichten, 1870, p. 166.)

HAPLOCERAS DAINTREEI, *Etheridge*, sp.

(Pl. I., fig. 3; Pl. II., fig. 6.)

Ammonites Daintreei, Eth., Quart Journ. Geol. Soc., 1872, xxviii., p. 346, t. 24.

Haploceras Daintreei, Eth. fil., Geol. and Pal. Q'land, &c., 1892, p. 495, t. 29, f. 1-3.

Sp. Char.—Shell discoidal, large, compressed; aperture high. Whorls, four preserved, rounded or subangular, the sides or flanks more or less flattened and convergent; abdominal angles rounded; umbilicus telescopic, moderately wide, and rather deep; the last whorl preserved exposing less than half the preceding, and the latter still less of the next oldest; umbilical edges of the whorls straight walled. Venter narrow and rounded, without keel; aperture broad-oval, high, the impressed zone moderately deep; siphuncle absolutely sub-ventran, one-eighth inch in diameter in a whorl with a transverse diameter of two and a-quarter inches immediately below the test, and traceable in decorticated specimens along the venter periphery; septa become less and less concave towards the last; septal necks short. Sutural lines of the septa both complex and deeply incised; ventral or siphonal lobes short, terminating in two short prolongations; superior lateral lobes very long, terminating in three principal branches or leaves, the centre one itself in three divisions; inferior lateral lobes narrow and long, only slightly less than the first lateral; first and second auxiliary lobes short, only serrate, without further subdivision; antisiphonal lobe deep; external saddles with two forward and two lateral leaves, the forward each of two branches, the lateral simple; first lateral saddle like the external only rather smaller; second and third lateral saddles not deeply divided. Sculpture consists of closely arranged, generally equal, rounded, or at times sub-angular ribs passing over the venter, becoming larger and less equal towards the aperture; intervening valleys shallow; neither furrows nor varices.

Obs.—This species appears to be of the type of *Haploceras Beudanti*, D'Orb. sp., and is a very characteristic fossil in a certain horizon of the Lower Cretaceous, developed in the basin of the Flinders River.

In no specimen that has passed through my hands have either the auricles or the ventral rostrum of the aperture been preserved. The sutures are very complex and difficult of description. No complete body whorl, or living chamber has yet been described, but the greater portion of it is exhibited in one specimen that I have succeeded in sectioning.

Loc. and Horizon.—Hughenden, Flinders River—Rolling Downs Formation (Lower Cretaceous).

Collections.—Sweet; and Geological Survey of Queensland.

Haploceras Flindersi, *McCoy*, sp.

Ammonites Flindersi, McCoy, Ann. Mag. Nat. Hist., 1865, xvi., p. 334; *Ibid*, 1867, xx., p. 196.

Ammonites Flindersi, McCoy, Trans. R. Soc., Vict., 1866, vii., p. 51; *Ibid*, 1868, viii., Pt. 1, p. 42.

Ammonites Beudanti, var. *Mitchelli*, Eth., Quart. Journ. Geol. Soc., 1872, xxviii., p. 345, t. 23.

Ammonites Flindersi, Eth. fil., Cat. Austr. Foss., 1878, p. 115.

Haploceras Flindersi, Eth. fil., Geol. and Pal. Q'land, &c., 1892, p. 494, t. 30, f. 1-3.

Obs.—Several fragmentary specimens, not sufficiently perfect to enable me to draw up any better description than that already existing,

still show that the ribs and folds described by Mr. Etheridge become strongly marked rounded varices on the venter, losing this feature on the flanks of the shells. In addition. one specimen exhibits distinct traces of fine spiral lines on the narrow periphery, producing a fine cancellation with the falciform striæ. In the figures of the late Mr. Daintree's specimens, given by Mr. Etheridge, these varices show on the flanks, and apparently not on the venter. Each varex is immediately preceded and followed by a shallow groove, the rear one often the more pronounced. There is, in fact, a strange combination of the sculpture features of Mr. Etheridge's *H. Mitchelli* and *H. Sutherlandi* in these specimens. The umbilicus, although ill preserved, seems to be narrow as in the latter of the two forms mentioned. Taken altogether, I am by no means satisfied either with this determination, or with the respective status of the two species in question. Some of the varices bear a single blunt and badly developed node in the middle line. There are no sutures visible.

The specimens are more or less compressed, with slightly convergent flanks and the abdominal angles well rounded.

Loc. and Horizon.—Marathon Out Station, Marathon—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

Genus Amaltheus, *De Montfort*, 1808.

(Conch. Syst., 1808, i., p. 91.)

AMALTHEUS OLENE, *Ten. Woods.*

(Pl. II., fig. 4.)

Ammonites olene, Ten. Woods, Journ. R. Soc. New South Wales for 1882 (1883), p. 150, t. 7, f. 2; t. 8, f. 1.

Ammonites olene, Eth. fil., Geol. Pal. Q'land. &c., 1892, p. 492, t. 29, f. 5; t. 30, f. 4.

? *Ammonites fontinalis*, Hudleston, Geol. Mag., 1890, vii. (3), p. 241, t. 9, f. 1.

Sp. Char.—Shell discoid, more or less compressed, number of whorls unknown, the inner nearly concealed by the last developed; test thin; flanks slightly convergent and divergent, but only slightly convex; venter tent-shaped and keeled, the keel prominent and rounded; umbilicus narrow, its edge sharp and straight-walled within, exposing small portions of some of the inner whorls; aperture high and narrow. Lobes and saddles of the septa intricate, the former narrow and elongate. Sculpture of strong somewhat flattened sigmoidal and occasionally bifurcating costæ; the latter narrow, close, and sub-radiate around the umbilicus, acutely bent forward in the middle line of the flanks, thence broadening out but not passing over the venter, spiral lines absent; at the forward inflection is an obtuse spiral or concentric ridge, from which the flanks are convergent towards the venter, and divergent towards the umbilicus.

Obs.—At first sight *A. olene* is very like *A. walshensis*, mihi,* but in the latter the venter is knife-edged, without a keel proper;

* Geol. Pal. Q'land, &c., 1892, p 493, t, 42, f. 10 and 11.

there is a spiral sculpture in addition to sigmoidal costæ, and the shell was probably even more compressed than in *A. olene*. The keel of the latter is decidedly cristiform, standing well above the venter, with a shoulder beneath it on each side. From the appearance of the crested venter in this species, I think the presence of a ventral lobe over the aperture may be inferred. So far as the characters of *A. olene* and *A. walshensis* are known, the two forms appear to be distinct; at the same time some of the characters of the two Ammonites so closely correspond that, allowing for differences of preservation, they may be identical.

Amaltheus Whiteavesi, White,* from the Cretaceous of Alaska, is specifically very close to *A. olene* in form and sculpture, but the digitations of the septa are unlike.

I have not been able to trace out a complete septum, but the digitation was very intricate.

Loc. and Horizon.—Walsh River—Rolling Downs Formation (Lower Cretaceous).

Collection.—Geological Survey of Queensland (*Pres.* P. F. Sellheim).

Genus Ancyloceras, *D'Orbigny*, 1842.

(Pal. Franç. Terr. Crét., I., Pt. 2, p. 491.)

Ancyloceras? *sp. ind.*

(Pl. II., fig. 5.)

Obs.—An imperfect Ancyloceriform shell was obtained by Mr. Sweet from the locality mentioned below that is different to any so far found in the Cretaceous of Australia, but still not sufficiently entire for perfect description. It is a naturally weathered longitudinal section of a shell that may be tentatively referred to *Ancyloceras*, although not wholly conforming to the characters of that genus. The portion preserved is two inches long, simply coiled once at the proximal end, or little more than crooked, and terminating with an obtuse point. The straight portion of the shell increases slowly in diameter, and where broken off exhibits a cross section of only half-an-inch. Within this space of two inches there are twenty-six chambers and part of the twenty-seventh, those at the curve being the deepest, whilst at the broken distal end the chambers are comparatively shallow. The septa as seen in section are, at the proximal end, practically straight, but as the shell is ascended, the septa commence to roll, forming three shallow lobes and three similar saddles, the rolling being gentle and wide. At the distal end the matrix is sufficiently worn away to display the siphon, which is large and well within the margin of the shell.

Loc. and Horizon.—Hughenden—Rolling Downs Formation (Lower Cretaceous).

Collection.—Sweet.

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* Bull. U.S. Geol. Survey (Powell's), 1889, No. 51, p. 69, t. 13, f. 1-5.

Genus Nautilus, *Breynius*, 1732.

(Dissertatio Phys. Polythalamiis.)

Nautilus (Cymatoceras ?) Hendersoni, *Eth., fil.*

(Pl. I., fig. 1; Pl. II., figs. 1-3.

Nautilus Hendersoni, Eth. fil. (m.s.), Geol. Pal. Q'land, &c,, 1892, p. 502.

Sp. Char.—Shell sub-globose, of medium size, deeply umbilicated in casts. Aperture large, transversely reniform, wider than long, margin gently rolling; the crests and sinuses not strongly marked; umbilical sinuses short; lateral crests wide; hyponomic sinus weak. Venter broadly rounded; impressed zone of the dorsum only moderately deep and wide. Umbilicus deep, slightly funnel-shaped, entirely exposed in casts. Siphuncle large, well marked. Chambers or cameræ increasing in length very gradually; section of the volutions from the umbilicus outwards somewhat less than a semicircle, due to a slight lateral flattening. Septa only moderately concave, from sixteen to eighteen to each involution; sutures exceedingly well marked in the cast, the ventral saddle gently rounded, but becoming less and less so as the apex is approached; lateral saddles (near theu mbilicus) slightly convex; lateral lobes, with a small degree of concavity, to nearly straight, the whole outline of the suture being a very gentle sigmoidal curve on each side the centre of the venter. Sculpture lines delicate, following the outline of the aperture; no costæ.

Obs.—*Nautilus*, using the term in its widest sense, has hitherto been absent from lists of our Cretaceous fossils, with the exception of the above reference. The present species, of which I have in all seen four specimens, conforms to a well-known Mesozoic type, represented by *Nautilus lævigutus*, D'Orb., *N. elyans*, J. Sby., *N. pseudo-elegans*, D'Orb., &c. Three of the examples are internal casts, or rather non-testaceous specimens, but the fourth has portions of the shelly layers remaining. The largest is five inches in transverse measurement, three and three-quarter inches in height, and three and a-half inches across the widest part of the aperture.

Of the four examples, three probably represent the neanic stage, and the fourth or largest the ephibic. The partially testiferous specimen, one of the former, displays the siphuncle in one of the cameræ in an absolutely subventran position, but in the largest *Nautilus*, or supposed ephibic stage, the siphuncle on the last exposed septum is as near as possible dorsocentran in position.

From a comparative point of view, specifically speaking, I can point to no better species than the Indian *Nautilus negama*, Blandford,* with its var. *crebricostatus*, and *N. Kayeanus* Blandford,† all of which the Queensland shell very closely resembles. In the Indian forms, however, the outlines of the sutures are much more undulatory; in other words, the convexities and concavities of the

* Pal. Indica—Foss. Cephalopoda S. India, Ser. 1, 1861, p. 35, t. 20, f. 2; t. 21, f. 1 and 5; Stoleczka, *Ibid*, Ser. 3, Pts. 10-13, 1866, p. 211, t. 22., t. 94.

† *Ibid.*, Ser. 1, 1861, p. 31, t. 16, f. 5 and 6; t 17, f. 1 and 2; t. 18, f. 1 and 2; t. 21, f. 2.

saddles and lobes are greater. It will, I believe, fall into one or other of Hyatt's genera—*Cymatoceras*,* or *Entrephoceras* †—possibly the latter, as the shell is not costate.

Named in honour of Mr. J. B. Henderson, Hydraulic Engineer to the Queensland Government.

Loc. and Horizon.—Wellshot Run, near Barcaldine; Ilfracombe; Maxwellton, near Hughenden—Rolling Downs Formation (Lower Cretaceous).

Collection.—Geological Survey of Queensland (*Pres.* Messrs. A. Lymburner, — Sheehey, and J Burkett).

III.—DESCRIPTION OF THE FIGURES.

PLATE I.

NAUTILUS (CYMATOCERAS ?) HENDERSONI, *Eth. fil.*

Fig. 1.—Internal cast, side view exhibiting the umbilicus, sutures, and cameræ.

Fig. 2.—Venter of the same specimen.

HAPLOCERAS DAINTREEI, *Eth. sp.*

Fig. 3.—Section of a medium-sized specimen exhibiting living chamber, septa, septal necks and cameræ.

ISOCRINUS AUSTRALIS, *Moore, sp.*

Fig. 4.—Terminal (?) portions of three arms, the two on the left united by an axil.

TATELLA MARANOANA, *Eth. fil.*

Fig. 5.—Hinge of an internal cast exhibiting the two cardinal teeth of the right valve, and the single cardinal tooth of the left, also the adductor scars.

PLATE II.

NAUTILUS (CYMATOCERAS ?) HENDERSONI, *Eth. fil.*

Fig. 1.—Internal cast exhibiting portion of the venter, sutures, a transversely reniform septum, and the siphuncle.

Fig. 2.—A smaller individual, rather imperfect, with remains of sculpture on the venter.

Fig. 3.—The same reversed, in naturally weathered section, exhibiting septa and siphuncle.

AMALTHEUS OLENE, *Ten. Woods, sp.*

Fig. 4.—Lateral views exhibiting the keeled venter and sigmoidally bent costæ on the flanks.

ANCYLOCERAS (?), *sp. ind.*

Fig. 5.—An imperfect example possibly of this genus.

HAPLOCERAS DAINTREEI, *Eth., sp.*

Fig. 6.—A suture with its lobes and saddles.

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* Proc. Boston Soc. Nat. Hist., 1884, xxii, p. 301.
Proc. American Phil. Soc., 1893, xxxii, p. 555.

INOCERAMUS CONSTRICTUS, *Eth.fil.*

Fig. 7.—An imperfect example, exhibiting the constriction, or cincture, from immediately in front of the umbone towards the ventral margin. (This drawing requires to be turned a half-circle to the right to bring it into its proper position.)

TATELLA MARANOANA, *Eth. fil.*

Fig. 8.—An example retaining the test.

MYTILUS PALMERENSIS, *Eth. fil.*

Fig. 9.—The right valve nearly entire.

PLATE III.

ISOCRINUS AUSTRALIS, *Moore, sp.*

(*Figs.* 1-3 represent different portions of the same specimen.)

Fig. 1.—On the left is arm γ, followed by δ and ϵ, each with thirteen ossicles, or places left vacant by the latter; I ax is in each case followed by its respective secundibrachs. On the right of the figure arms θ and i are renewed at the monaxils (1 Ax.)

Fig. 2.—Represents the specimen as seen in Fig. 3, somewhat canted forwards. On the left edge portions of arm ϵ are seen; on the centre the bases of the arms θ and i, and beyond the gap these arms are renewed from 1 Ax with succeeding distichals and tetrastichals.

Fig. 3.—At the bottom of the figure part of the dorsal cup is seen on the right, and below it remains of a few primibrachs of arms δ and β, followed by brachialia of arm γ, the left (δ) and right arms (ϵ) of the next ray. In the succeeding ray the left arm (θ) is represented by four monostichals, and the right (i) by three. Beyond the fracture gap appear the monaxils, and some distichals.

TATELLA MARANOANA, *Eth fil.*

Fig. 4.—Internal cast exhibiting the open and shallow pallial sinus, indication of cardinal teeth cavities, and the adductor impressions.

MACCOYELLA SUBSTRIATA, *Moore, sp.*

Fig. 5.—An imperfect left valve, with the alate posterior end.

INOCERAMUS CONSTRICTUS, *Eth. fil.*

Fig. 6.—A large and imperfect example, exhibiting the anterior constriction or cincture.

PLATE IV.

GLYCIMERIS RUGOSA, *Moore, sp.*

Fig. 1.—A nearly entire specimen.

SOLEMYA CRETACEA, *Eth fil.*

Fig. 2.—A partially decorticated example.

MACCOYELLA ROSTRATA, *Eth. fil.*

Fig. 3.—A partially preserved cast of the left valve, with the right valve showing beneath on the right hand.

MACCOYELLA SUBSTRIATA, *Moore sp.*

Fig. 4.—A partially preserved cast of the left valve.

SERPULA TRACHINUS, *Goldfuss?*

Fig. 5.—Portion of a tube partly weathered from the matrix.

Fig. 6.—Section of tube prepared for the microscope — × 2.

LUNULITES ABNORMALIS, *Eth fil.*

Fig. 7.—Sub-cupuliform or slightly infundibuliform colony, with the zoœcia removed, and exhibiting the concave ribs (obverse) and perforations.

Fig. 8.—Casts of the zoœcia — × 3.

[No. 158 of the Geological Survey Publications.]

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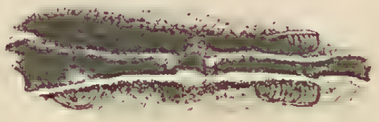

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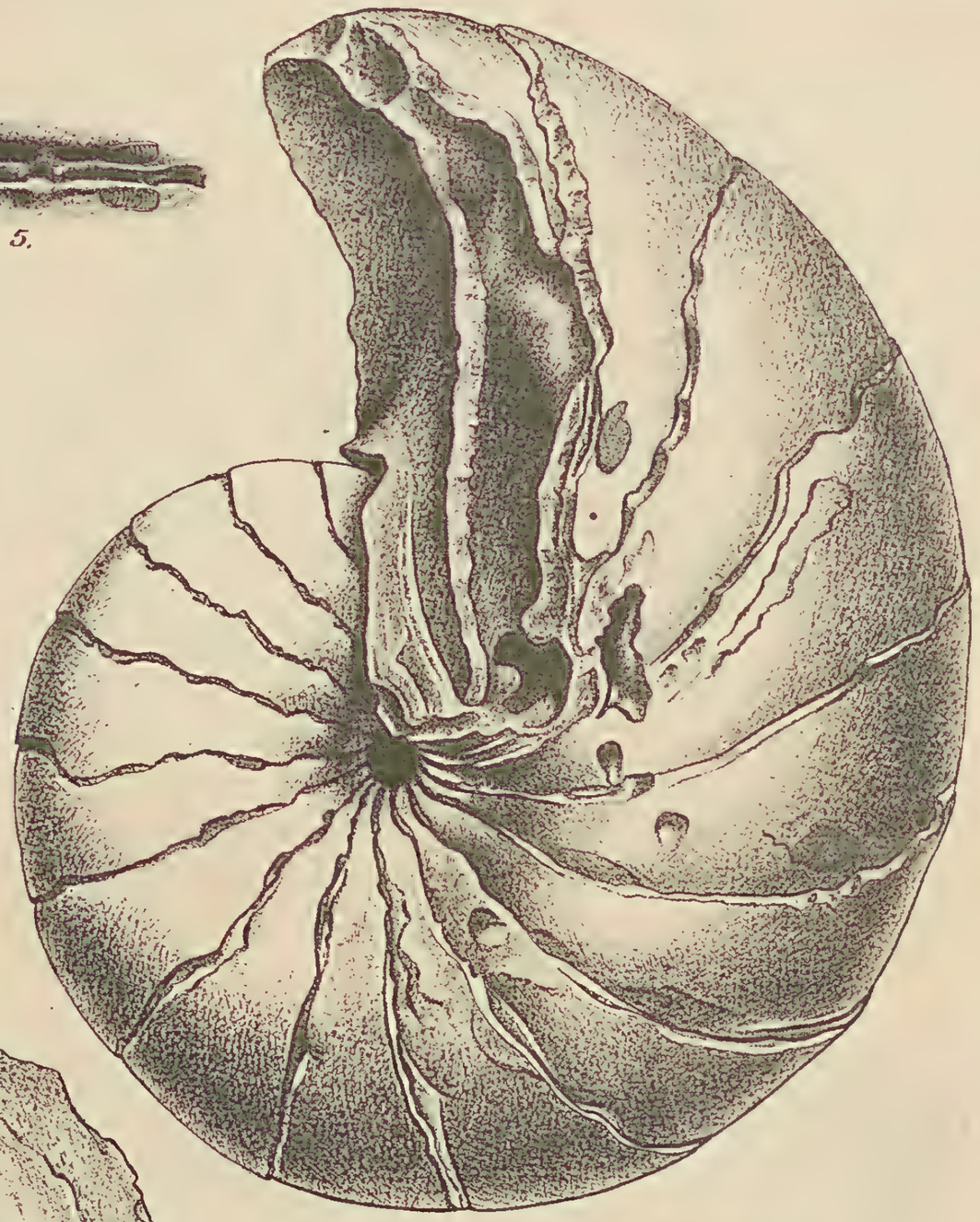

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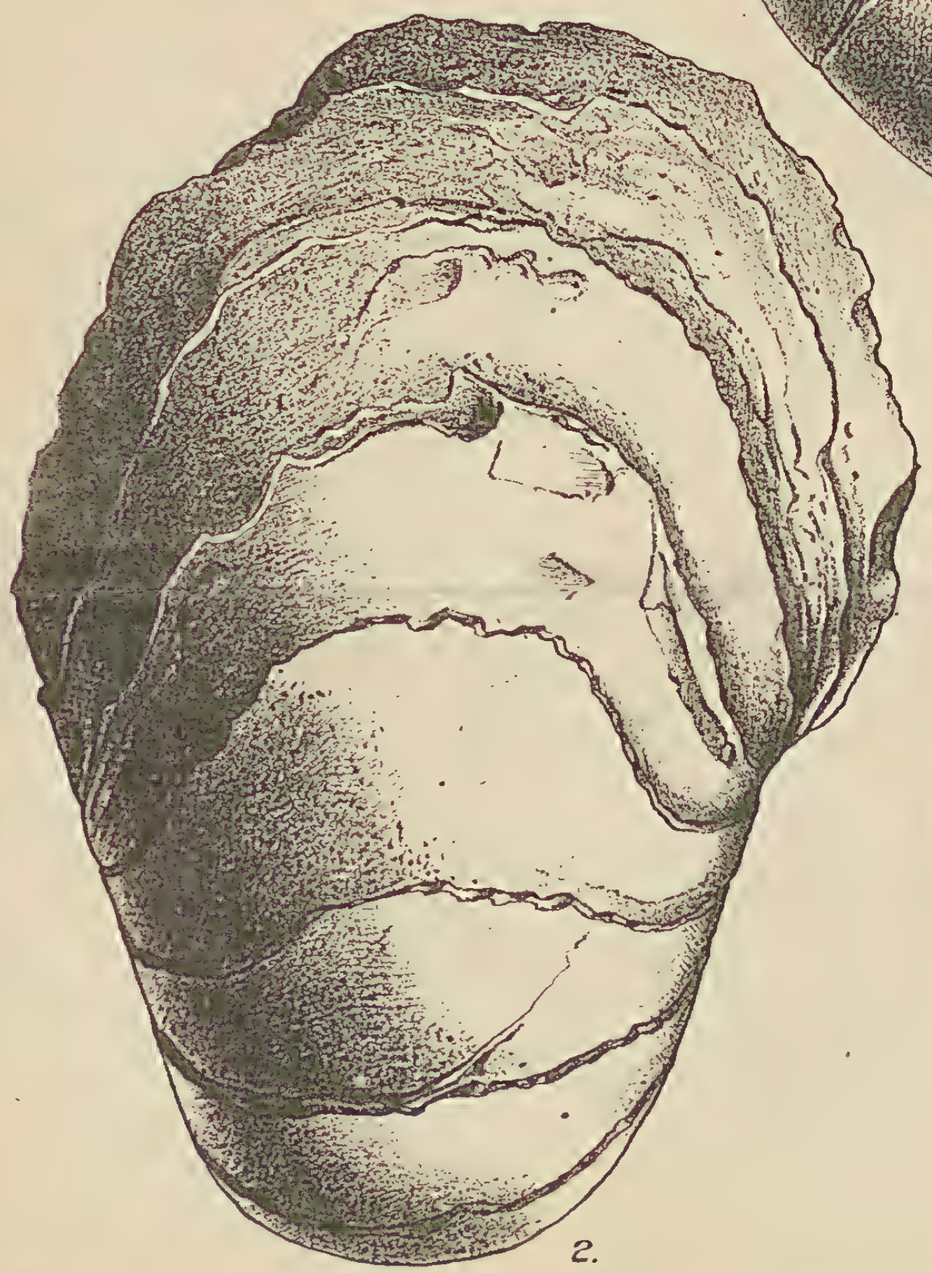

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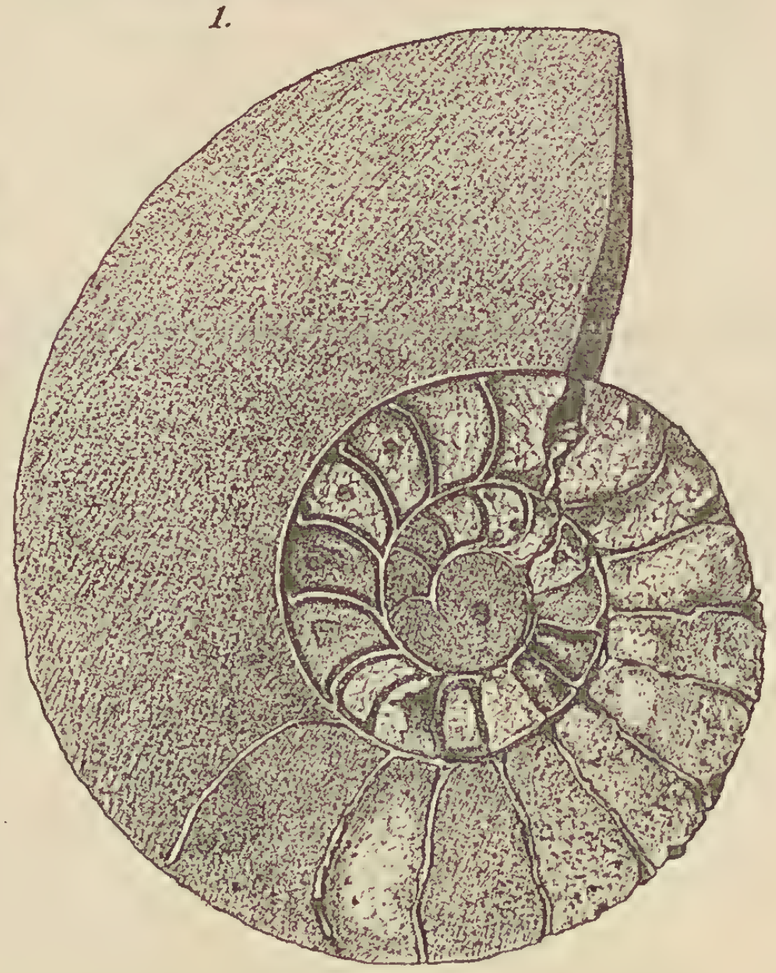

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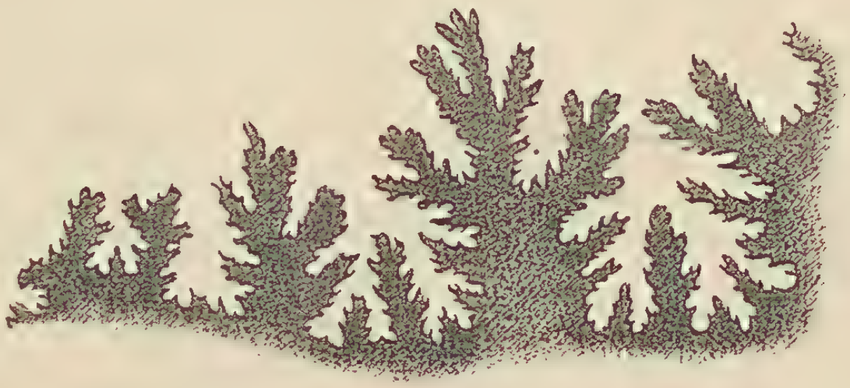

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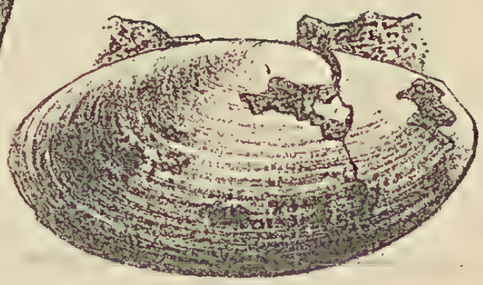

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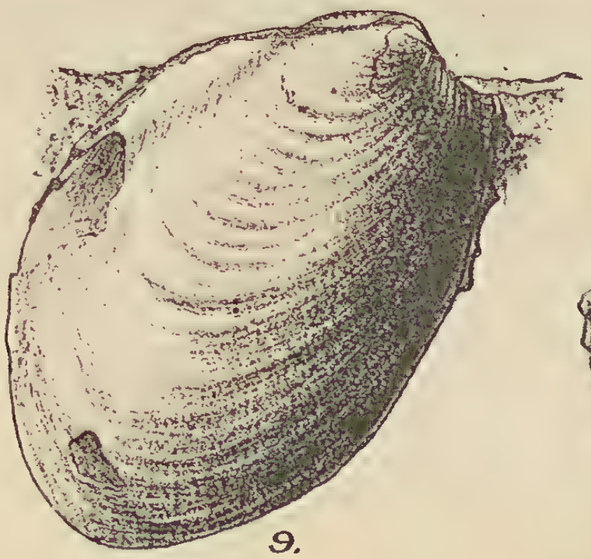

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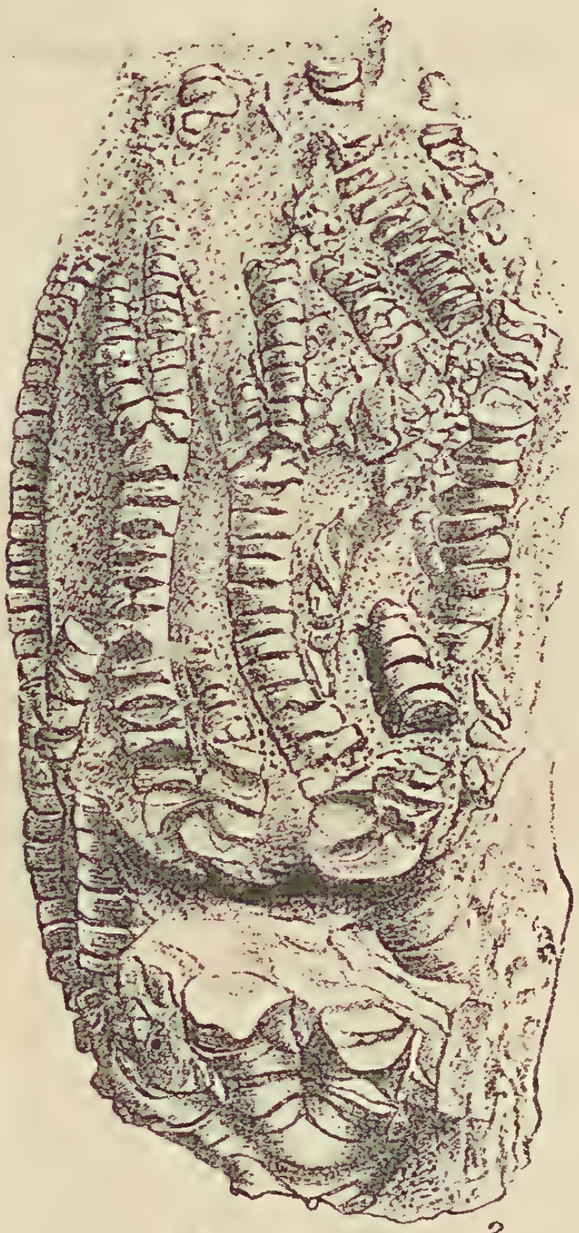

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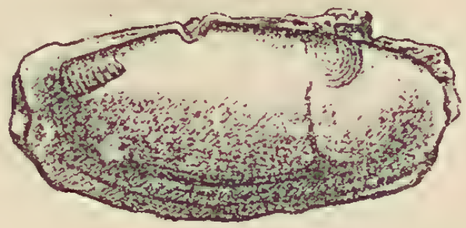

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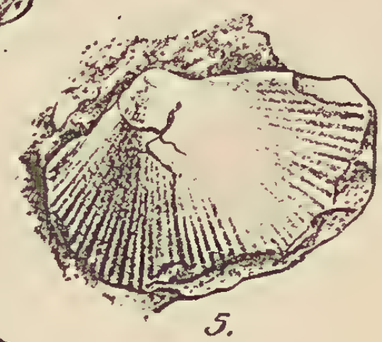

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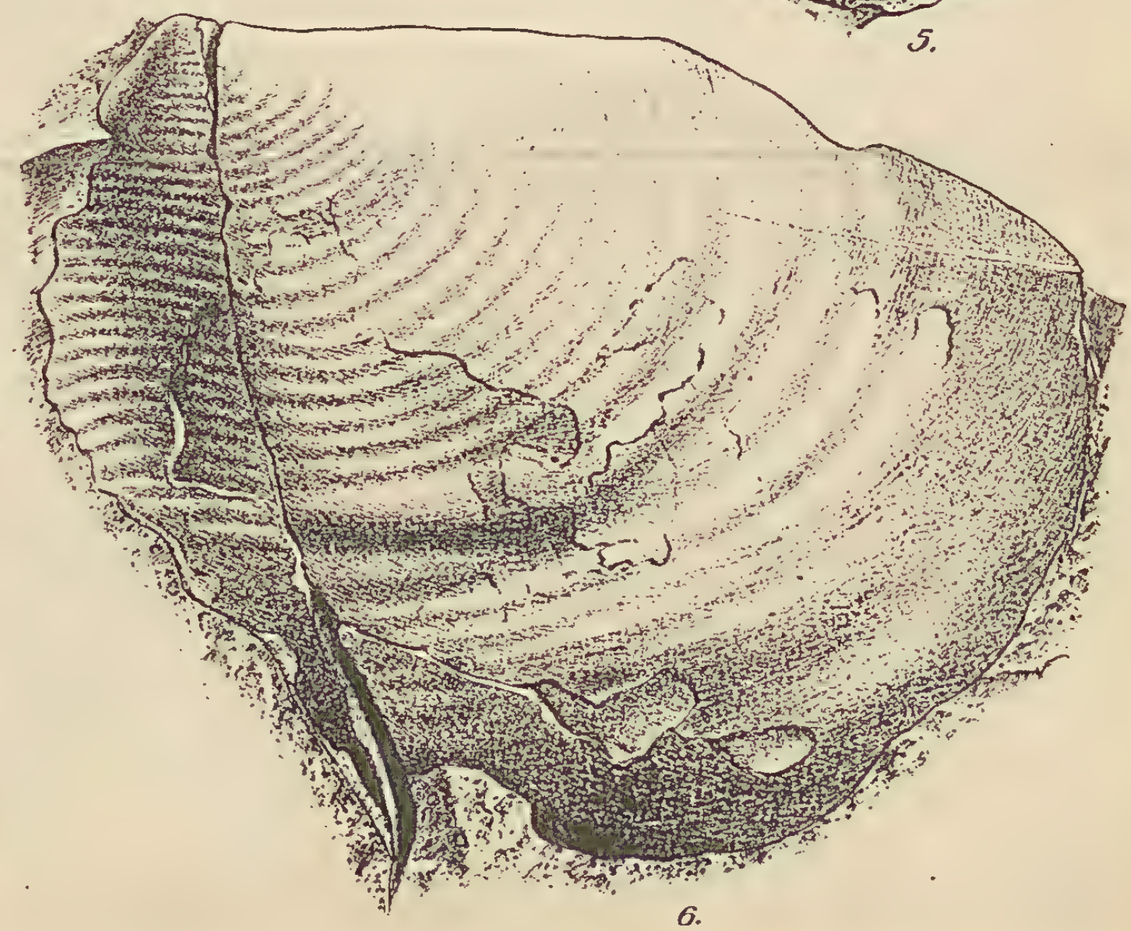

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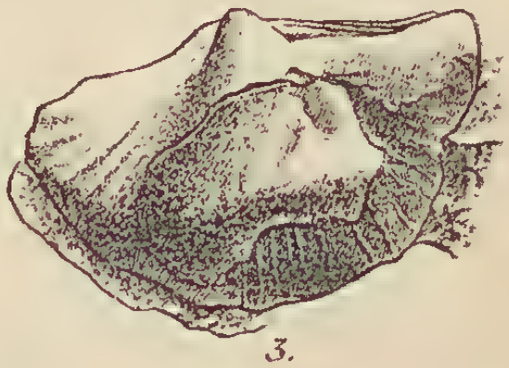

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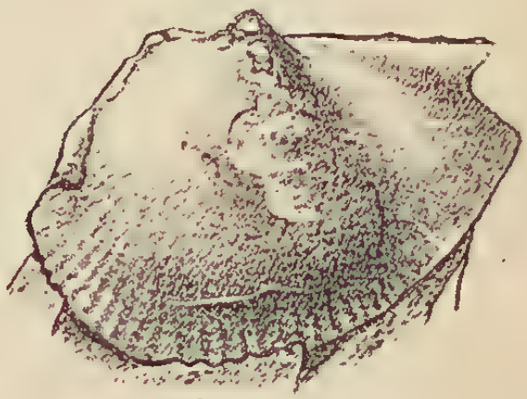

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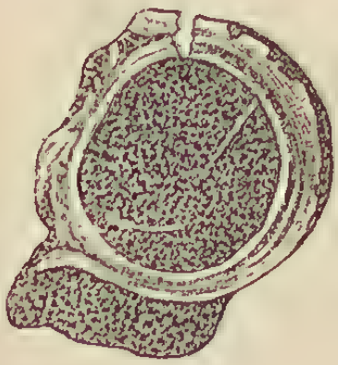

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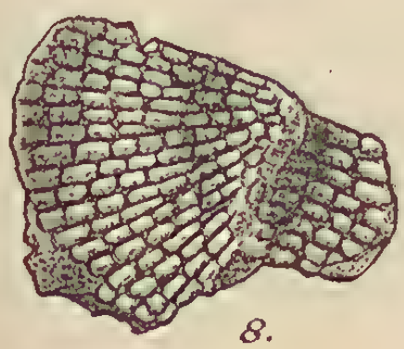

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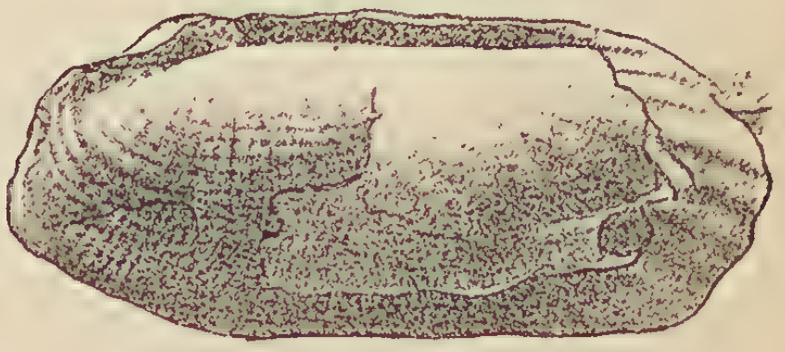

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Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 14.

THIRD REPORT

ON THE

EIDSVOLD GOLD FIELD,

WITH

NOTES ON MCKONKEY'S CREEK DIGGINGS AND ANTIMONY LODE.

By WILLIAM H. RANDS,
GOVERNMENT GEOLOGIST.

BRISBANE:
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1901.

LETTER OF TRANSMITTAL.

To The Honourable The Minister for Mines.

Geological Survey Office,
Brisbane, 29th April, 1901.

Sir,—

I have the honour to forward herewith my Report, entitled "Third Report on the Eidsvold Gold Field, with Notes on McKonkey's Creek Diggings and Antimony Lode," and to recommend that it be published as Bulletin No. 14.

I have, &c.,

WILLIAM H. RANDS,
Government Geologist.

THIRD REPORT ON THE EIDSVOLD GOLD FIELD, WITH NOTES ON MCKONKEY'S CREEK DIGGINGS AND ANTIMONY LODE.

By WILLIAM H. RANDS, Government Geologist.

In September last I visited Eidsvold to make an inspection of the latest developments in the mines, and to report to the Minister for Mines on an application from the Lady Augusta Company for a subsidy out of the deep sinking vote.

I have published two previous reports on this field, one in 1887,* when the field had only just commenced. A rough sketch map accompanied this report. The second report, with a geological map on the scale of 4 chains to an inch, was published in 1895.† Since that map was published, the boundaries of the leases have been altered to a considerable extent.

In 1899, however, Mr. J. B. Fitzgerald, Licensed Surveyor, Eidsvold, published a very useful map, showing the leases, levels, &c., with their relative and actual depth from the surface; and the relative levels of the shafts at the surface.

Although a considerable amount of prospecting work was done in the latter end of the sixties, it was not until early in the year 1887 that Mr. Achilles discovered the Mount Rose Reef, and thus led to the development of the field. In a very short space of time a township sprang up with a fairly large settled population, which in 1890 numbered nearly 1,500.

The output of gold from the field rapidly rose from 1,243 oz. in 1887 to 15,823 oz. in the year 1890, and the stability of the field seemed assured. The following two years showed a falling-off, however, with 10,732 oz. and 14,307 oz. respectively; and from that time there has been a gradual falling-off in the output, until last year (1900) it reached the low figure of 1,412 oz.

This falling-off in the output has to a large extent been due to the failure in the deeper levels of the Mount Rose Reef, which has been by far the largest gold producer on the field.

Throughout the Mount Rose P.C., and the western portion of the Mount Rose and Stockman Junction, this reef gave good yields of

* Report on the Eidsvold Gold Field by William H. Rands, Assistant Government Geologist. Brisbane: By Authority: 1887.

† Second Report on the Eidsvold Gold Field by William W. Rands, Assistant Government Geologist. Brisbane: By Authority: 1895.

gold, but at a vertical depth of about 300 feet, and at a horizontal distance of from 700 to 800 feet from the outcrop, the quartz gave out, although the large "formation" continues. Much the same thing has happened in the Minerva Lease, the workings in which are about 500 yards to the east of those in the Mount Rose and Stockman Junction.

The New Heights of Alma, a block lease on the Mount Rose and Stockman Junction, appeared from its position to have every chance of success at the time the shaft was being sunk, but owing to the quartz cutting out a large amount of money has been expended with very poor results, the total output being only a little over 3,000 oz. The vertical depth at the bottom of the winze from the 356-feet level, which is the deepest point reached on the reef, is 443 feet.

Blank patches are known to have occurred in many of the reefs on Charters Towers, and payable stone has come in below, and as this goldfield in many respects resembles that of Charters Towers it is very probable that the same thing may occur here.

In my Annual Report for the year 1900,* page 3, I say:—

"The shoot of the Mount Rose Reef may have gone away to the north-west, where no prospecting has been done beyond the 247-feet level, and the best chance of picking up the gold appears to me either to sink a new vertical shaft away to the dip in that direction, or to go down with one of the western underlie shafts on the reef. I expressed this opinion to several of the managers when on the field, and I understand that an attempt is to be made in that direction."

Unless the Mount Rose and other reefs do prove payable at greater depths the days of the field are numbered, and the population must gradually dwindle.

In 1899 the population of Eidsvold, including the St. John's Creek and Dykehead Gold Fields, had decreased to 737.

In November last a Government subsidy was granted, out of the vote for deep sinking, to the Lady Augusta Company to assist them in sinking their shaft on the Augusta Reef, which was down about 350 feet, with the object of meeting with the junction of that reef and the Mount Rose Reef. The latter reef is supposed to have been cut in the Empress Shaft at 309 feet, and it has a much flatter underlie than the Augusta Reef.

Nothing is known of the Mount Rose Reef so far, to the east, and I am of opinion that there would have been a better chance of success had a strong company been formed to sink a deep shaft to the south-west of the Mount Rose and Stockman Junction, and had the subsidy been granted to them.

In my former reports I gave an account of the geological features of the field, and in my 1895 report (*loc. cit.*) was the following short description:—

"The greater portion of the field consists of a medium-grained granite, which is a light pink in colour, consisting almost entirely of quartz and felspar, with a little brown mica, and a very little hornblende.

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* Annual Progress Report of the Geological Survey for the year 1900. Brisbane: By Authority.

"The eastern part of the area included in the map is occupied by a dark-coloured rock, which is much finer in the grain. This rock is intrusive in the granite, and has sent out dykes into it. When examined in thin sections under the microscope it proves to be a quartz-mica diorite, the technical name for which is tonalite. It consists of small felspar crystals, chiefly plagioclase, hornblende, brown mica, and blebs of quartz. The quartz and mica are full of enclosures of apatite. There are a few specks of magnetite. Where this rock is in the dykes in the granite it passes into a true diorite, made up entirely of plagioclase, felspar, and hornblende, with a few crystals of magnetite.

"When I first examined the field I was under the impression that the granite passed insensibly into the diorite, but now the ground is cleared of timber it is plain that there is a distinct line of demarcation between the two, and that the diorites are intrusive in the granites. The diorite is known on the field as "dark-coloured granite." The diorite closely resembles that on the Charters Towers Gold Field, which also occurs in large masses, and sends out dykes into the surrounding granite."

An appendix is attached to this Report showing the number of tons crushed, and the annual output of gold from the commencement of the field in 1887 to the end of the year 1900.

While at Eidsvold I paid a flying visit to McKonkey's Creek, and a few notes on the auriferous lead, and also on the antimony lode there are given at the end of this Report.

The Craven Extended, G.M.L. No. 93.

The area of the lease is 25 acres.

The Craven Reef is the most southerly one that has been worked on the field. When I first visited Eidsvold in the year 1887 this reef had not been discovered, and in 1895 none of the claims on the line were at work, so this was the first opportunity afforded me of seeing any of the workings.

The Craven Reef runs south-east and north-west, and underlies very flatly to the north-east.

The north-east level, at 300 feet in depth, has been driven 107 feet. In the face of this drive there was no quartz, only a diorite "formation." The drive followed a reef from the shaft for a distance of 70 feet, when it thinned out. This reef averaged about 3 inches in width, and carried fairly good gold; at times it increased in size up to about 7 inches, but in such places it was generally very poor in gold.

At the 240-feet level, which is in 120 feet to the north-east, the reef was followed for about 100 feet before it cut out. In this level it was very small, and hardly averaged more than 1½ inches, but carried good gold.

At the 190-feet level the south-east drive is 180-feet level, and the reef cut out close to the face, which is in a grey granite. The average width of the reef was 4 inches. The reef contained no gold in the first 80 feet from the shaft, when it was in diorite country. From that point to the end of the level it averaged about 4 oz. to the ton, and in places it was from 6 to 8 inches in width. The country rock was granite.

At the 100-feet level the reef, which averaged from 6 to 8 inches in width, cut out at about 210 feet south-east of the shaft. For the first 125 feet from the shaft it was in diorite, and contained but little gold, but beyond that point it contained payable gold. The reef was underlying very flatly at about 1 in 8 or 10.

In 1899 this company crushed 141 tons of stone for 340 oz. 5 dwt. of gold.

From the above description it appears that the "shoot" of gold-bearing stone is about 100 feet in width, and is dipping away to the north-west on the plane of the reef.

There is great difficulty in making such a small reef pay in comparatively hard country.

The Lady Augusta, G.M.L. No. 45.

The area of this lease is 15 acres.

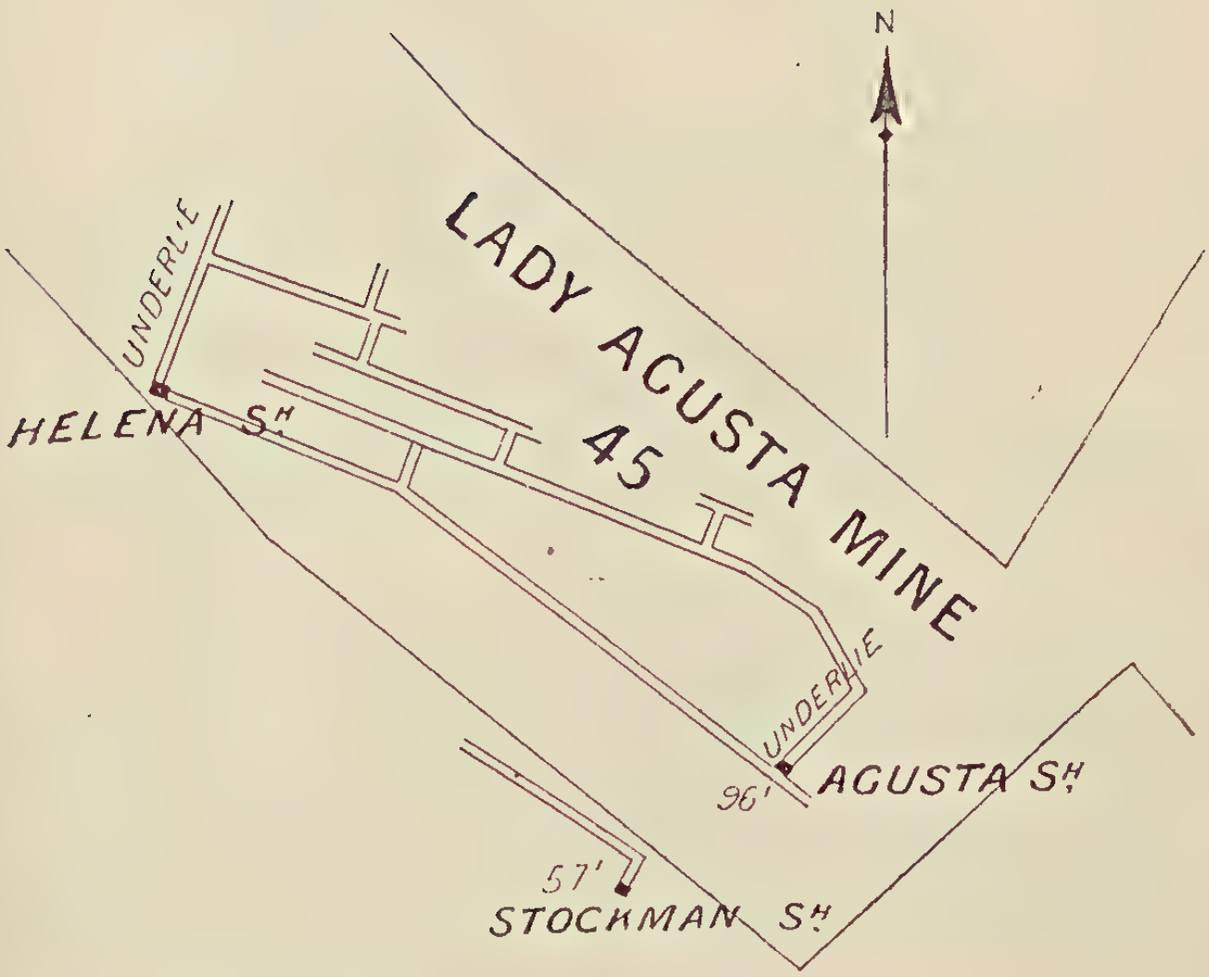
One of the chief objects of my visit to the field was to examine this mine, as the company had applied to the Government for a subsidy from the vote in the aid of deep sinking, which has since been granted to them.

The subsidy was asked for with a view of sinking the Helena Shaft on this lease to a depth at which it should cut the Mount Rose Reef at its junction with the Lady Augusta Reef. The Mount Rose Reef has been largely worked on the north-eastern portion of the field, and the Mount Rose and Stockman Junction, and the Mount Rose P.C., paid large sums in dividends.

The Mount Rose Reef bears east and west, and dips to the south at an angle of about 1 in 2¾. The Lady Augusta Reef, on the other hand, bears north-west and south-east, and underlies steeply to the north-east at about 2 in 1. As the outcrop of the Lady Augusta Reef is situated to the south of that of the Mount Rose, it is evident that if the two reefs continue downwards they must junction with one another. The depth at which they should junction has been calculated by Mr. J. B. Fitzgerald at about 240 feet vertical below the present workings of the Lady Augusta, or at a total vertical depth from the surface of 590 feet.

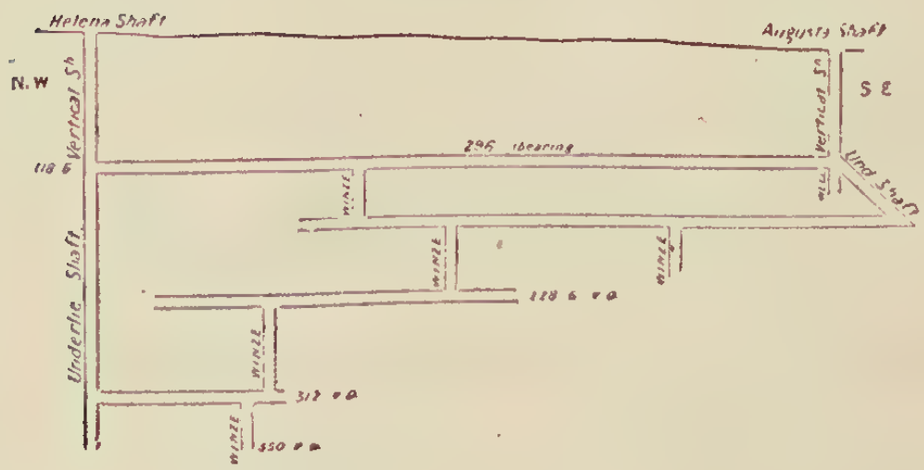
This calculation is based on the presumption that a reef formation cut in the Empress Shaft at a depth of 309 feet is the Mount Rose Reef, and this seems more than probable—firstly because when pumping was going on from the Empress Shaft, water standing in the underlie shaft on the Mount Rose Reef in the New Heights of Alma Mine was drained off to a certain extent; and it also rose again in the shaft when pumping was stopped; and, secondly because although the Empress Shaft was sunk to a depth of 810 feet, and a crosscut about 670 feet in length was driven in a south-westerly direction at a depth of 790 feet, no other reef was met with. The Mount Rose Reef would have had to bend over and underlie at a very much steeper angle than the average for it not to have been met with at that depth.

Fig. 1.



Plan of the Mine on a Scale of 132 Feet to an Inch.

Fig. 2.



Longitudinal Section of the Mine on the Scale of 150 Feet to an Inch.

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Unfortunately the Empress workings were filled with water, so that I had no opportunity of examining the formation.

The Lady Augusta Reef was first worked under the name of the Stockman Reef, to the south of, and just outside the boundary of the present Lady Augusta Lease.*

The workings here were at shallow depths, and the reef was dipping very flatly. The same flat dip continued in the underlie from the Augusta Shaft in the Lady Augusta Lease, but at about 100 feet north of the bottom of that underlie the reef suddenly bent over and assumed a much steeper underlie.

I examined the workings of the Augusta Shaft when I visited the field in the year 1895,† and reported on them as follows:—

"The shaft is vertical down to the 96-feet level, when the Lady Augusta Reef (formerly called the Stockman Reef) is cut. This reef is bearing about north-west, and underlying to the north-east at an angle of about 22 degrees from the horizontal.

96-feet Level.—On following along the north-western drive at this level for 350 feet a diorite dyke is seen in the footwall of the reef, running in an east and west direction. On the northern side of the dyke the level makes a bend, and the reef is dipping at a steep angle, about 65 degrees from the horizontal. The reef has been worked above the bend to the south of this, where the dip is about 22 degrees. The quartz was about 3 inches in width on an average, and went at the rate of 3 oz. of gold to the ton. The value of the gold was £3 15s. per oz. Below where the reef bends over steeply a trial crushing of 8 tons was taken out, which yielded gold at the rate of 1 oz. per ton. In the face of this level, about 500 feet from the shaft, the reef, which is in the middle of 3 feet of granitic formation, is about 4 inches in width, and contains very little pyrites.

The south-eastern level has been driven for 60 feet in length. Good stone was obtained in this level close to the shaft, but beyond that the reef was much broken. This drive was worked by the old Stockman Company, and has not since been tried.

125-feet Level.—The underlie at this shaft is still flat, but the reef takes a steeper underlie at 100 feet north-west of the shaft in this level. The total length of this drive is 230 feet. For the first 50 feet from the shaft there was no reef, but only the granitic formation. The reef then began to make again, and an average width of 3 to 4 inches of quartz, going about 1 oz. of gold to the ton, has been worked out to the upper level. At this level I had a better opportunity of seeing the point where the reef bends over and takes the steep underlie, and it looks as if another reef with a steep underlie had joined the reef originally worked. In the face of this drive there was only 2 inches of quartz, with about 2 feet of granitic formation. The underlie was being sunk, but had not quite reached the point at which the reef takes the steep dip."

The Augusta Shaft is now abandoned, and work is being carried on from the Helena Shaft, which is situated about 650 feet north-west of the former.

A plan and section of the mine are given in figures 1 and 2. These figures are taken from a survey of the mine by Mr. J. B. Fitzgerald, Mining Surveyor.

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* For a description of these workings *see* Report on the Eidsvold Gold Field by William H. Rands. Brisbane: By Authority: 1887, pp. 3 and 4.

† Second Report on the Eidsvold Gold Field, by William Rands. Brisbane: By Authority: 1895.

Helena Shaft.—The shaft is vertical for 118 feet 6 inches. At this depth a level has been driven in a south-easterly direction to connect with the Augusta Shaft. A good portion of the reef above this level has been worked out. The reef was from 6 to 8 inches in width, and consisted of a clear glassy-looking quartz, with some hard quartz coloured red with oxide of iron. The country rock is granite. The shoot of gold-bearing stone extended from the shaft for about 100 feet along this level, and then there was a blank until the Augusta shoot was reached.

The reef in the level is underlying at a steep angle of about 2 in 1 to the north-east, but 30 feet above the level it has the same flat dip as in the Augusta Shaft.

About 100 feet down the underlie shaft from the bottom of the straight shaft, a level has been driven in a north-westerly direction, which is known as the 218-feet level. The shoot of auriferous stone crosses the shaft at this point showing that it has a north-westerly dip on the plane of the reef. This shoot has been worked out from 30 feet above the 118-feet level down to this one.

The level is in about 100 feet in length, and the shoot occurred nearly to the face of the level. The reef was small, not averaging more than 3 to 4 inches in width. The rock is granite.

Another level, the 270-feet level, has been driven in a north-westerly direction at 150 feet down the underlie. In the face of this level the walls of the reef are about 3 feet apart. There is a thin layer of quartz on the footwall, and about 3 inches in width of quartz on the hanging-wall. The formation is wider here than in any other part of the mine, and it consists of alternate layers of a highly felspathic rock and diorite.

The bottom level, known as the 340-feet level, is at a vertical depth of 312 feet.

Close to the shaft in the drive going south-east there is from 8 inches to 1 foot of quartz on the hanging-wall, but it carries little or no gold, while on the footwall there is 2 inches in width of quartz with a fair amount of gold. As a rule the gold occurs in the hanging-wall leader, except where it widens out, and then it generally contains very little gold. About 50 feet along the level the two leaders come together and carry a little gold. The country in this portion of the level is diorite.

Nothing payable was found in the level for 115 feet when a shoot of gold, 70 feet in length along the reef, was met with. This is the same shoot that was worked in former days from the Augusta Shaft. A winze was sunk on this shoot for 42 feet. The reef in the winze in the level, and for about 100 feet above the level, averaged about 3 inches in width. There is a quantity of calcite with the quartz here. The reef in the face of the level is 6 inches wide and consists of hard quartz.

The bottom portion of the shaft is much flatter than the average dip of the reef, and I believe it is above the reef; but as it was full of water it is impossible to speak with any certainty on this point. The

total crushings from this ground up to the end of the year 1899 are 2,467 tons of stone for 8,296 oz. 9 dwt. of gold, equal to 3 oz. 7 dwt. 5 gr. per ton.

The reef is very small all through the mine where it carries payable gold, and although rich patches are met with here and there, it will never be payable unless it increases in size on going down, or where it junctions with the Mount Rose Reef.

In an old shaft south-east of the Augusta Shaft masses of solid stibnite (sulphide of antimony) occur in the reef.

The New Heights Alma, G.M.L. No. 30.

The area of the lease is 25 acres.

I visited this mine chiefly to see the winze that has been sunk from the bottom level down to a vertical depth of 443 feet. This is the deepest point at which the Mount Rose Reef has been touched.

In 1895 I reported as follows on the Mount Rose Reef in the Lease* :—

"*Alma Main Shaft.*—The vertical depth of this shaft is 340 feet, and below this there is an underlie shaft 130 feet in length, which is full of water, nearly up to the level.

On rising to the 305-feet level in the western drive, there is about 9 inches in width of quartz in a granitic formation. The quartz is very white, contains but little mundic, and averages only 5 dwt. of gold per ton.

265-feet Level.—There is a flat granitic formation at this level, which contains very little quartz. The country rock is granite. In a crosscut at 120 feet north of the shaft, quartz begins to make in this flat reef, and it is from 6 to 8 inches in width. An assay of this quartz yielded gold at the rate of 15 dwt. to the ton; but on a crushing being taken out it only went two or three pennyweights. This is the same flat reef that occurs between Nos. 6 and 7 Levels in the Mount Rose and Stockman Junction."

The winze has been sunk for 340 feet from the bottom level at a point about 130 feet west of the Alma Underlie Shaft, and nothing payable was met with. Near the top of the winze there is a little quartz in a soft granitic formation in a country rock of granite.

At 170 feet from the top the winze was sunk some distance on an upper formation which was underlying flatly. Although this was a good-looking formation it carried no gold and the sinking on it was stopped, and that on the lower formation continued.

At 240 feet down the winze drives were put in east and west. In the western drive there was a formation 18 inches in width but no quartz, in a pinkish-grey coarse-grained granite. Close to the shaft there was 2 inches of quartz, but it carried no gold. In the eastern drive there was from $1\frac{1}{2}$ to 2 inches of quartz, carrying very little gold.

At the bottom of the winze there were some small rock-bound leaders of quartz in a hard diorite formation, the country rock being still a grey granite.

This company has had a most unfortunate experience, having expended many thousands of pounds in prospecting the Mount Rose

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* *Loc. cit.*

Reef, just below where it paid such good dividends to the Mount Rose and Stockman Junction Company, without meeting with any payable stone.

The total result of the crushings from this mine for the years 1893 to 1899 inclusive, is 2,956 oz. 15 dwt. of gold from 1,137 tons of stone crushed, or an average of 2 oz. 12 dwt. of gold per ton.

The Maid of Erin Reef in this lease has been abandoned. In 1895* I reported upon it as follows:—

"*Maid of Erin Shaft.*—This shaft is situated 6 chains east-north-east of the Main Alma Shaft. It is down 90 feet in depth vertically to the Maid of Erin Reef, which is a flat reef above the Mount Rose Reef. The underlie from the bottom of the vertical shaft is 78 feet in length, in a direction east 25 degrees south, and is inclined at an angle of 15 degrees from the horizontal.

The reef, at the bottom of the underlie, is about 3 inches in width, and is in the middle of the granitic formation, which is about 5 feet in width. The tributors at work on this reef had crushings which went from 1 oz. 5 dwt. to 6 oz. of gold per ton. At the bottom of the vertical shaft the reef is on the footwall.

On rising on the reef from the bottom of the vertical shaft for a distance of about 40 feet, the quartz is about 9 inches in width, and diorite takes the place of the ordinary granitic formation above the reef.

The Lady Rose Reef.

The Lady Rose Reef crops out about 18 chains to the north of the outcrop of the Mount Rose Reef. This reef, though discovered some time ago, I believe, has only lately been worked. In what is known as the Gold Mines Lease, formerly known as the West Lady Rose, there is a vertical shaft 70 feet in depth to the reef, and then an underlie of 120 feet in length, running in a south-easterly direction. This underlie is very flat, but it does not follow the true underlie of the reef, which is nearly due south at 20 degrees.

At the bottom of the underlie there is 1 foot in width of quartz, not unlike that obtained from the Mount Rose Reef near the surface. The quartz is stained with green carbonate of copper, and shows free gold in places.

A drive has been put in to the east, and the reef was being stoped away above this level. It averaged about 1 foot in width throughout, and it is in a nice soft granitic formation rock in a granite country.

About 300 tons have been crushed, which yielded about 1 oz. of gold per ton, worth £3 16s. per oz.

A second underlie driven due south has been started.

In the Lady Rose Lease they have not been successful yet in getting on to payable stone, though a small reef from 4 to 10 inches in width has been driven on. The enclosing country is hard granite.

The Mount Rose and Stockman Junction Company were sinking one of their shafts to intersect this reef, which is underlying towards their ground. This was the only work being done by the Mount Rose and Stockman Junction Company.

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* *Loc. cit.*

The Minerva, G.M.L. No. 68.

The area of this lease is a little over 24 acres. A portion of this ground was originally worked by the Golden Spur Company. The present workings are being carried on from the No. 3 shaft. The reef worked by the Golden Spur Company was cut in this shaft at 96 feet in depth, while that being worked by the present company is at 168 feet in depth.

I went along the old workings, and up the underlie to the bottom of No. 2 Shaft, which is at a depth of about 135 feet from the surface. Some of these old workings are not in too good a condition, but they are only being used for travelling, and a good watch is being kept on them by the manager.

From the bottom of this No. 2 shaft a new level was being driven in a north-easterly direction, and quartz about 1½ inches in thickness, carrying good gold, was met with. The reef broke away to the south a few feet along the level, and from that point increased in size up to about 1 foot.

At 160 feet in, a fault, dipping east 20 degrees north at 55 degrees, does not displace the reef, but the latter contains no gold for a few feet beyond it.

I next proceeded along the old workings to the Golden Spur Shaft. In the level diorite occurs on the hanging-wall, and a grey granite on the footwall. At 25 feet from the Golden Spur Shaft a dyke of decomposed diorite is seen running east 30 degrees south; this is probably, from its direction, the same that was met with in cross-cut from and 115 feet south of, the Empress Shaft at 790 feet in depth.

On the western side of the shaft a level is being driven on a reef 1 foot in width, but it carries little or no gold.

Along the western face of the stopes the reef was too poor to continue working it, and in No. 3 level the country is much disturbed and the reef only 2 inches wide. The rock here is a decomposed diorite.

In the western drive from the No. 3 shaft the reef, which contains little or no gold, is in a decomposed diorite formation with a grey granite in the hanging-wall.

The payable stone in this lease occurred above a line running in an east and west direction.

It is now proposed to cut the reef by sinking to the east of the old shaft near the Court House Reserve. This appears to me a very good method of working, as it would not only open up fresh ground but also improve the ventilation.

The Empress, G.M.L. No. 28.

The area of this lease is 25 acres. When I visited the field in 1895 the shaft was down to a depth of 575 feet; since then it has been sunk to a depth of 810 feet, and a cross-cut was put in to the south-west towards the Minerva for a distance of 680 feet at the 790-feet

level; nothing however was met with in the crosscut with the exception of a flat rock-bound leader of quartz, which was followed for some distance. A cross-cut was also put in to the north-west for 280 feet.

The only formation met with was that in the shaft at a depth of 309 feet, which is referred to above in the description of the Lady Augusta Mine.

This shaft was full of water at the time of my visit.

McKONKEY'S CREEK DIGGINGS.

These diggings are better known locally as The Springs, and they are situated about 16 miles south-west of Eidsvold, between McKonkey's and Hungry Hill Creeks.

The lead runs in an easterly direction from Spring Creek, a small tributary of McKonkey's Creek, up a ridge running in a north-easterly direction, which divides that creek from Hungry Hill Creek.

Spring Creek derives its name from the occurrence of small springs, which keep the creek always running, even in the driest seasons.

Where the lead occurs the ridge is covered with a sandy soil, and the timber consists of bloodwood, cabbage-gum, blue-gum, quinine, and dogwood. This is about half a mile across, and on either side the granite appears at the surface, where the timber is chiefly hardwood.

Beginning at the most easterly shafts, I first descended Macpherson's Shaft, which is about 500 feet east of the P.C. Shaft, and which bottomed at 53 feet in depth. The wash was dipping in a north-easterly direction out of their ground, so the claim was abandoned.

Claims to the north-east of Macpherson's were forced to stop sinking at between 30 to 40 feet in depth on account of water. A shaft 100 feet north-west of Macpherson's bottomed at 37½ feet in depth on wash carrying gold, but not in payable quantities; and in another shaft 100 feet north of that again similar results were obtained.

Harvey's and Caper's claim is situated north-east of and next to the P.C. Claim. The shaft bottomed at a depth of 38 feet. On the bottom there was 3 feet of wash, but it only carried about 3 dwt. of gold to the ton, not sufficient to pay. Above the wash is a hard, white, fine, cement, about 4 inches in thickness, consisting of quartz and felspar. Above that again is another washdirt 10 inches in thickness, with large white quartz pebbles in the bottom, and smaller ones throughout it. The wash is of a clayey nature. This is now being worked, and from the prospects obtained it is anticipated it will go about 10 dwt. of gold to the load. A parcel was being put through while I was there. Above this is a ferruginous sand for a few inches, and then a sand containing pebbles of quartz and quartzite. The floor of the washdirt dips to the north-east and is very uneven.

On the P. C. Claim two shafts have been sunk 57 feet apart. The western shaft bottomed at 25 feet in depth and the eastern at 38 feet. The bed-rock is a soft decomposed granite, consisting of a grey felspar quartz, with a little mica and hornblende. The washdirt is very coarse

and hard—so hard is it that it has to be put through a battery. They have been taking out about 2 feet to 2 feet 6 inches in thickness of this washdirt; the top portion contains scarcely sufficient gold to pay, but in places on the bottom it is very rich and has prospected up to 5 dwt. to the dish. The last lot put through was 51 tons, which yielded 15 dwt. of gold per ton. One crushing of 3 tons yielded 5 oz. per ton. About 50 feet in breadth of washdirt is being worked, but it is thinning out at either side.

I found an interesting boulder from this claim of a very hard polished quartzite full of fossilised wood beautifully preserved in every detail.

The wash gets gradually shallower going in a westerly direction, while at The Springs Creek, or Gully, surfacing is being carried on, the yield being from 3 dwt. to 6 dwt. to the load.

The lead has not been traced west of the workings first described, and it is very doubtful whether it will be as there appears to be more water than can be kept under with a windlass and bucket, and the lead is not of sufficient extent or richness to warrant the expense of erecting an engine on the ground to keep the water under while searching for the continuation of the gold-bearing washdirt.

McKONKEY'S CREEK ANTIMONY LODE.

This is situated about a mile nearly due south of The Springs Lead.

The lode was worked as far back as the years 1876 to 1878, and was then abandoned, I believe, on account of the expense of carriage of the ore. It has not been worked since, and the old shafts have either fallen in or are full of water. I could see, however, a good section of the lode in an open cut close to the most westerly shaft.

The lode bears east 30 degrees north, and is nearly perpendicular; it is 3 feet in width. On the northern wall there is a small vein of quartz, then from 12 inches to 16 inches of solid stibnite (sulphide of antimony), next there is 10 inches of a soft granitic formation, formed from the debris of granite, and lastly on the southern wall of the lode another 10 inches of solid stibnite. The surrounding rock is granite.

The lode can be traced for over a mile in an easterly direction, and it was worked about a mile to the east, near Hungry Hill Creek in the early days, when several mineral selections were taken up on it.

About 200 yards south-west of the shaft, in a gully, slates striking east and west and nearly perpendicular are to be seen. The slates here are very micaceous and metamorphosed, but about a quarter of a mile further south they are not so altered. The junction between the granite and the slate runs in a north-west and south-east direction.

In travelling from Eidsvold to McKonkey's Creek granite was traversed as far as the Burnett River crossing; on the south-western side of the Burnett slates, quartzites and limestone, &c. (Gympie Beds?) extended for about 6 miles; then came 2 miles of black soil flats, and then the granite in which the McKonkey Creek Diggings are situated, which was traversed for 7 miles in a south-westerly direction to the slates above mentioned, south-west of the diggings.

APPENDIX.

RETURN SHOWING THE ANNUAL OUTPUT OF GOLD AND QUANTITY OF QUARTZ CRUSHED FROM THE EIDSVOLD GOLD FIELD SINCE THE COMMENCEMENT OF THE FIELD.

Year.	Quartz Crushed.		Yield of Gold.		
	Tons	cwt.	Oz.	dwt.	gr.
1887	1,324	15	1.243	13	0
1888	7,768	4	6,907	0	4
1889	15,933	10	15,446	8	4
1890	20,909	16	15,823	1	10
1891	14,084	4	10,732	14	12
1892	10,732	1	14,307	4	19
1893	7,398	15	7,328	7	3
1894	4,102	15	4,865	1	10
1895	2,222	18	3,903	10	20
1896	3,163	11	4,912	15	0
1897	3,380	5	3,284	2	15
1898	3,163	0	7,993	16	8
1899	3,040	10	4,159	7	22
1900	981	5	1,412	10	22
Total	98,205	9	102,323	6	9

[No. 160 of the Geological Survey Publications.]

By Authority: EDMUND GREGORY, Government Printer, William street, Brisbane.

1901.

Queensland.

GEOLOGICAL SURVEY.

BULLETIN No. 15.

REPORT

ON

SOME MOUNT MORGAN MINES.

By B. DUNSTAN, F.G.S.;

Assistant Government Geologist.

WITH THREE PLATES AND THREE PLANS.

NATIONAL MUSEUM MELBOURNE

BRISBANE:

BY AUTHORITY: EDMUND GREGORY, GOVERNMENT PRINTER, WILLIAM STREET.

1901.

LETTER OF TRANSMITTAL.

To The Honourable The Minister for Mines.

Geological Survey Office,
Brisbane, 27th April, 1901.

Sir,—

I have the honour to forward herewith Mr. Dunstan's Report on "Some Mount Morgan Mines," with Three Plates and Three Plans, and to recommend that it be published as Bulletin No. 15.

I have, &c.,

WILLIAM H. RANDS,
Government Geologist.

SOME MOUNT MORGAN MINES

REPORT ON, BY B. DUNSTAN, F.G.S., ASSISTANT GOVERNMENT GEOLOGIST.

[With three Plates and three Plans.]

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Contents:

1. LIGHT OF DAY MINE.
2. HIDDEN TREASURE MINE.
3. MORGANITE MINE.
4. GLEN DEE.
5. CONCLUSIONS.

ACCORDING to instruction, the Mount Morgan district was visited for the purpose of examining some of the numerous gold-mining properties where prospecting operations are now in progress. As well, some general notes have been made on the geology of parts of the district examined, and have been incorporated in the present Report.

(1) LIGHT OF DAY MINE.

(See Plan 1.)

This property is situated to the south of the Mount Morgan Company's leases, and prospecting has been carried on in three places—the Light of Day Shaft, the No. 1 Tunnel close to the shaft, and the No. 2 Tunnel driven into the "nameless" mountain. Reference has been made to these by Dr. Jack in his last Report on the Mount Morgan mines.*

The Light of Day Shaft is now 293 feet deep. The sinking from the surface to forty-five feet below was through alternating hard and soft gossan containing from 1 dwt. to 3 dwt. of gold per ton. From this

* Mount Morgan and other Mines in the Crocodile Gold Field (Fourth Report)—R.L.J., Brisbane: By Auth.: 1898, G.S.Q., pp. 11-12,

position in the shaft to the bottom the sinking was through a quartzite at a depth of seventy-five feet in the shaft, carrying small cubes of pyrites, and at ninety feet a similar formation, two feet six inches thick, appears horizontally, but with the cubes of pyrites about half-an-inch in diameter. At 100 feet another dyke about three inches thick shows in one corner of the shaft and continues vertically to the bottom of the shaft, spreading in one place to three feet in thickness but usually very much smaller.

At 150 feet in the shaft the stone yielded, it is said, at the rate of 10 dwt. of gold to the ton, and at 162 feet it yielded over 15 dwt of gold. At 168 feet assays showed as much as 17 dwt., but further down the stone gave from traces to 4 dwt.

The stone near the top of the shaft, just below the gossan, resembles very much the stone near the bottom of the shaft, and they both seem to belong to the same bed. If this be so, some movements must have taken place to bring the bed they are portions of into a vertical position.

At 215 feet, at 235 feet, and at 275 feet there are vertical leaders of felspar, but they die out along what might be bedding planes of the strata.

Two levels have been driven, the top level at ninety-five feet and the bottom one at 182 feet. One of the drives at the top level has a bearing of W. 15° S., and has a length of thirty-five feet, of which the first fifteen feet is in quartzite, assaying 3 dwt. of gold, then five feet of dyke rock, then fifteen feet of "weeping" conglomerate containing 1 dwt. of gold.

At the same level, ninety-five feet, another drive has been put in for a distance of 151 feet in a direction east-north-east. The first twenty-five feet is in a quartzite containing 5 dwt. to 7 dwt. of gold to the ton, the next forty-seven feet is in a dioritic rock showing vertical cleavage cracks parallel with the length of the drive. Quartzites, seventy feet thick, is next met with, generally containing from 1 dwt. to 2 dwt. of gold, but occasionally reaching 4 dwt., then fourteen feet of an altered basic igneous rock to the end of the drive.

The bottom level at 182 feet has a bearing W. 5° N. and a length of 124 feet. The first fifteen feet is in hard quartzite, assaying from 1 dwt. to 3 dwt. of gold, then sixty-four feet of "weeping" conglomerate.

This conglomerate, or agglomerate, is made up of subangular fragments of basic and acidic rocks and appears to have undergone some severe metamorphic changes. Portions of the rock are highly acidic and in structure somewhat concretionary, while other portions are basic. This concretionary structure is conspicuous where the rock has fretted away at the end of the western drive on the top level and where the rock has in places become cavernous. One cavern has weathered into a hole some twenty feet above the roof of the drive, and because of its shape is called the "chimney," a sketch of which is shown in Fig. 1.

This conglomerate in parts of the bottom level contains pyrites, and assays about 1 dwt. of gold.

Further along the drive in the same level and next to the conglomerate there are eight feet of dioritic rock, then conglomerate again for twenty-four feet, assaying up to 1½ dwt. of gold, then a granite (?) to the face of the drive.

Fig. 1.

CROSS SECTION AT THE TOP LEVEL (56 feet).

Showing the weathering of the "weeping" conglomerate to form the "chimney."

As the general tendency of the formations—judging from the appearance of the quartzites, the conglomerates, and the intrusive rocks—is to repeat themselves in depth, to obtain a change of formation it would be necessary to put in a drive across the country. As granite occurs to the west, the direction for future operations would be towards the east and at or below the bottom level. Further information is shown on the accompanying plan (Plan 1).

No. 1 Tunnel is situated close to the shaft and has been driven westerly for about fifty feet. It does not call for special mention at present, although the sections of the rocks exposed will be of use when the geological surface features of this district are examined.

No. 2 Tunnel in the "nameless" mountain, which we might very appropriately call Mount Gilmore in honour of the man who has

been so much associated with the development of these mines, is about half-a-mile easterly from the shaft, and on the eastern side of the Dee River, opposite Tipperary Point. A view of this mountain is shown on Plate 3. Sections of the formations penetrating the base of the mountain are exposed in the cuttings along the river bank near the tunnel, and they throw some light on the trend, the mode of occurrence, and the mineral composition of the rocks.

The tunnel has been driven into the side of the mountain a distance of about 110 feet in a south-easterly direction. Many local changes are observed in the character of the rocks exposed in the drive, all the stone giving varying results on assay, but all indicating that the belts of country are nearly parallel with the drive, and that instead of proceeding with the drive in the present direction it would perhaps be better were it driven more north-easterly.

(2) HIDDEN TREASURE MINE.

(See Plan 2.)

This tunnel is situated immediately south of the west works of the Mount Morgan mine and on the southern side of Mundic Creek. Since the mine was examined and reported on by Dr. Jack in 1898* further exploratory has been done, so a general outline of the whole of the workings will be given.

The main tunnel has been driven for a distance of over 400 feet in a general south-westerly direction, but varying between south-west and south, and has three branch drives referred to here as Nos. 1, 2, and 3 respectively.

At sixty-eight feet in the main tunnel a lode was passed through having a north-westerly underlie. No. 1 branch (see accompanying Plan 2) has been driven westerly, and a winze which has been sunk on it has met the lode penetrated in the main tunnel, which is inclined in this westerly direction. This branch is continued on the other side of the winze for about eighty feet, and is in decomposed granitic rock all the way. At the face the rock is only partly weathered and shows concretionary weathering, an indication that a little further on the massive undecomposed rock might be met with.

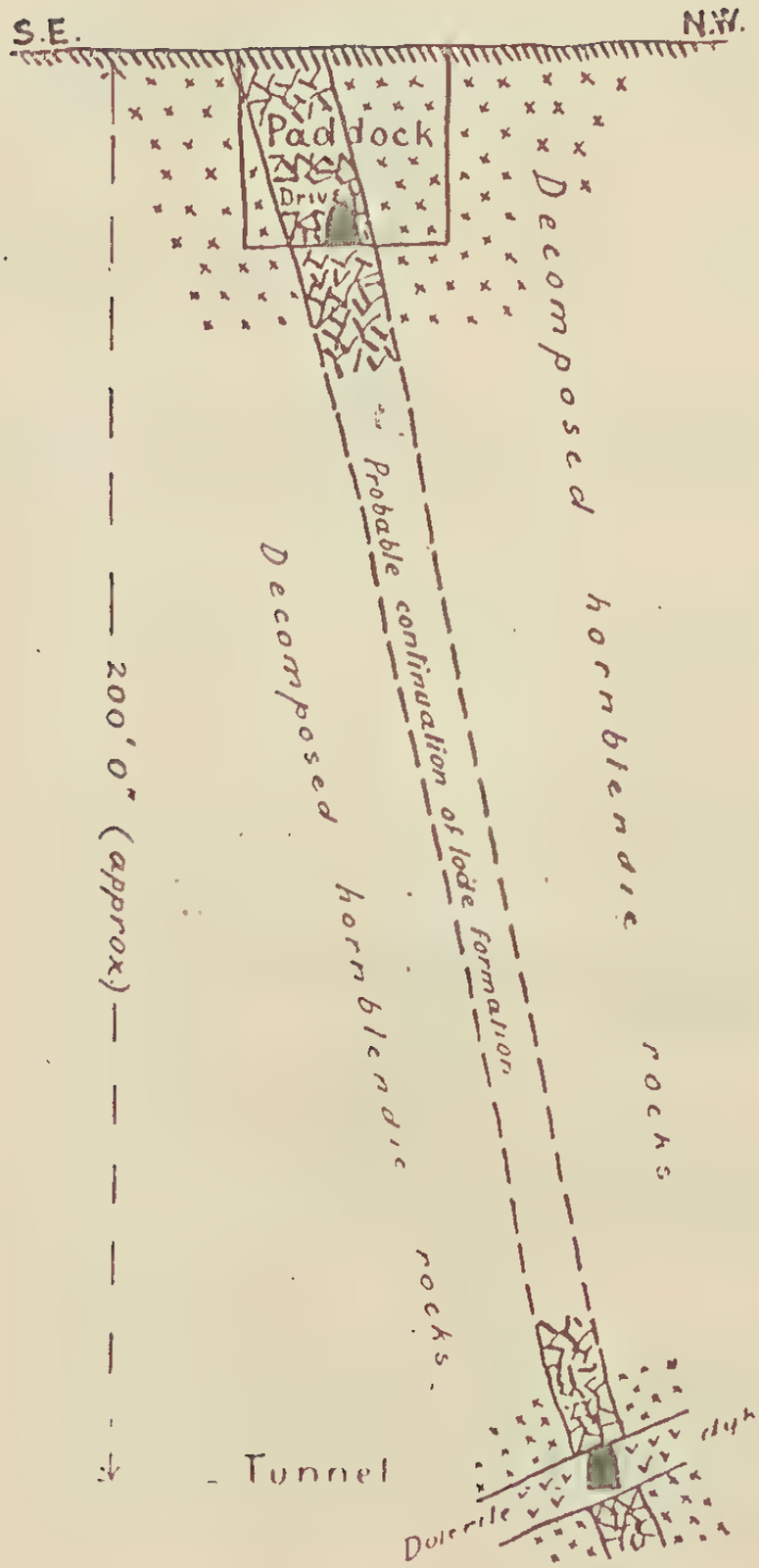
The main tunnel is continued on to the No. 2 branch through a coarse-grained decomposed hornblendic rock, which might have been a syenite or diorite. A vein in this rock contains calcite and a zeolite, *heulandite* (?), and another vein, which originally contained crystals of iron pyrites has decomposed, and *limonite* has been formed as pseudomorphs after these crystal.

In No. 2 branch, which has a bearing W. 20° N., and a length of fifty feet, the rocks are holocrystalline and hornblendic, and show no indication of a lode formation.

No. 3 branch, about thirty-four feet further along the main tunnel, has a bearing S. 28° E., and a length of sixty-one feet. A mass of quartzite was penetrated between coarse-grained hornblendic rocks, and was thought to be "involved" in these igneous rocks, but which

* *Loc. cit.* (Fourth Report), p. 11.

Plate 1.



Cross Section, Hidden Treasure Mine, Between the "Paddock" on the Hill and the Main Tunnel, showing the Probable Connection of the Lode Formations.

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now are indicated to be probably a continuation of the lode found in the main drive nearer the mouth, and also that found below in the winze, and along the main tunnel towards the face.

The main drive from the mouth of the No. 3 branch is continued S. 25° W. for thirty-six feet through decomposed rock, where the lode shows on the south-western side. The drive is then continued south-west for thirty-eight feet, at the junction of the hanging-wall of the lode and the decomposed igneous rock, until a dolerite dyke is met with. After penetrating this dyke, which is six feet thick, the course of the drive is changed to S. 10° W. and continued for twenty-six feet, passing through the quartzite into a partly decomposed hornblendic rock, which is either syenitic or dioritic, and where now work is proceeding.

Assays of the quartzite from a number of places in the workings have been made from time to time, and show that the stone contains gold from traces up to 12 dwt. to the ton, but so far nothing has been found which can be considered very satisfactory.

Regarding the trend and continuation of the quartzites the general strike is north-east and south-east as shown on Plan 2, the general inclination being towards the north-west at a very steep underlie.

A "paddock" has been cut out for prospecting purposes on the side of the hill above the tunnel level, and the formation there, which underlies to the north-west, is said to have assayed 4 dwt. of gold to the ton. This formation is evidently the same as that found in the tunnel as its continuation, according to the underlie, would take it down to the workings below—the face of the tunnel not being immediately below the "paddock," but to the north-west of it as shown in Plate 1.

Considering all the details shown in the workings below, and also what is shown on the surface, the quartzites met with in different places can hardly be called fragmentary masses caught up in the igneous rocks, but rather that they are a defined lode formation having a strike north-east and south-west and an underlie of about 15° (from the vertical) to the north-west.

Should it be desired to further prospect this quartzite lode, the prospectors must bear in mind its south-west strike, which would be parallel with that portion of the main drive between the 336 feet and 394 feet, and that this would be the direction to expect a continuation of it, instead of driving in the direction they were taking at the time of the inspection.

Should it be advisable, on the other hand, to prospect across the country for other lodes, the best direction would be either north-west or south-east. Again, if it be desired to prospect the lode on the level of the tunnel between the places where it is found at the entrance of No. 1 branch and the middle of No. 2 branch, then about thirty feet of driving in a south-easterly direction at about 200 feet along the main tunnel should strike it. Of course, at the same position in the tunnel a winze also would cut the lode below, but judging from the

angle of underlie of the lode the depth where it would be found in a winze will probably be greater than the distance to meet it by a cross-cut.

(3) THE MORGANITE MINE.

This mine is situated away to the north-west of the property of the Mount Morgan North Company in a small but steep gully having a south-east (?) direction, and leading down from the Desert Sandstone capped ranges above.

The lode exposed in this watercourse has been prospected by a shaft 103 feet deep. At fifty-seven feet an altered dyke rock nine inches thick was penetrated, and is dipping at an angle of about 35° to the north-north-west. At seventy feet a similar dyke was penetrated having the same thickness, bearing, and angle of dip.

The lode is a quartzite, cryptocrystalline in structure, with blebs of corroded quartz contained in it, and is highly charged with iron pyrites. The dyke rocks also are highly mineralised. The width of the lode has not been determined, as the shaft is in this formation from top to bottom. As no satisfactory assay results have been obtained from the stone which has been passed through in sinking the shaft, perhaps it would be better to determine by driving what the lode is like near the walls. As the watercourse, evidently, has been cut through the rocks on one side of the outcrop of the lode, it will be better first to drive away from this to avoid as along as possible any necessity for extra pumping appliances, and after this side has been prospected then to test the other wall.

(4) GLEN DEE.

(See Plan 3.)

Glen Dee is an old alluvial mining camp on the Dee River, about five miles directly east-north-east from Mount Morgan, and about a mile southerly from the reefs at Struck Oil.

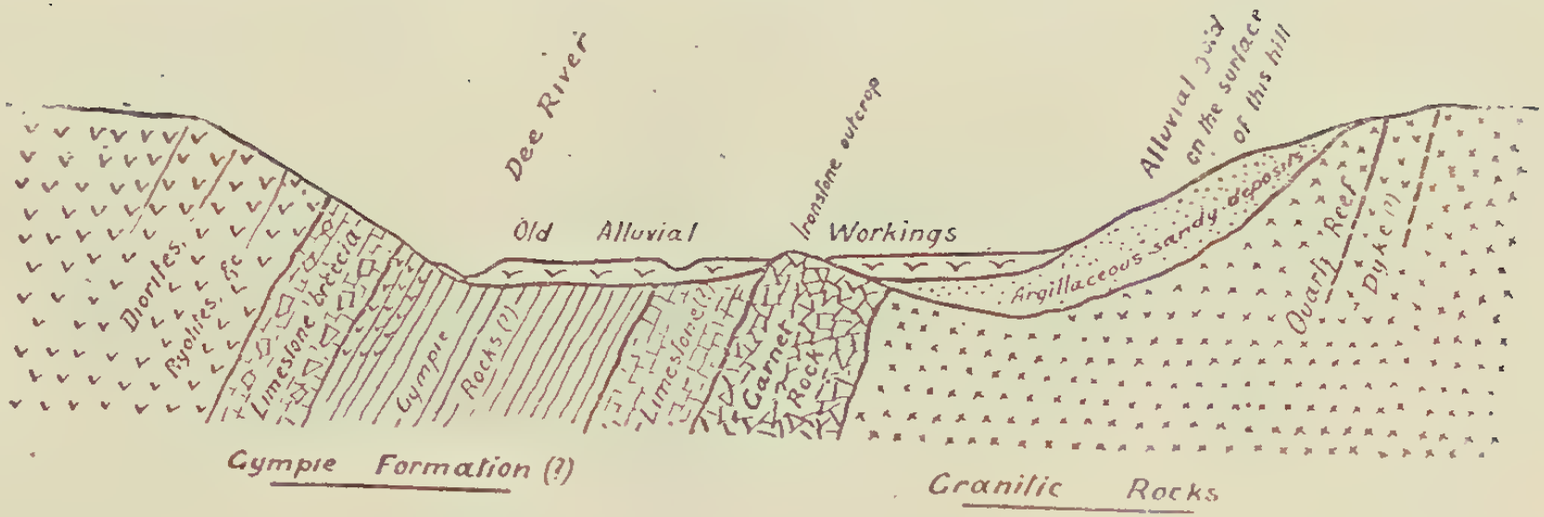
About thirty years ago it is said there were as many as 2,000 alluvial miners camped at the one time on this place. Some of the rich patches in the alluvial yielded as much as 1 oz. to the dish, and about the places marked (c) on the accompanying Plan 3, 6 and 7 dwt. pieces of gold were picked up.

It has been suggested that the hill to the west of this alluvial flat is the locality where the gold came from originally, and that it has been deposited there in a lode or some such formation.

The trenches which have been cut on this hill do not show any indications of lode formation, being a rotten, argillaceous, gritty sandstone, in which water-worn pebbles of quartz are present.

Stratigraphically the deposit has many peculiarities in common with the formation known as the "Desert Sandstone." They resemble the argillaceous beds frequently found interbedded with this formation, and should they belong to it the gold found on the Glen Dee flat and on the hill might have been contained in a sedimentary bed or in an old lead which possibly existed immediately above the beds the hill is composed of.

Plate 2.



SKETCH SECTION AT GLEN DEE, NEAR MOUNT MORGAN, SHOWING THE PROBABLE RELATIONS OF THE DIORITES, LIMESTONE, GYMPIE ROCKS, GARNET ROCK, AND GRANITE.

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Consequently, in any further prospecting by trenching or sinking on the hill, the gold will probably be found under such conditions as would be expected in a deposit of sedimentary origin. As the older Gympie rocks occur to the north, south, and west, possibly a comparison might be drawn with the conditions which prevail at Mount Victoria, where the gold occurs at the base of the Desert Sandstone.

There are several geological formations in the neighbourhood of Glen Dee. Limestones and other sedimentary rocks have been disturbed by granite masses, in all of which fissures have been formed, and with mineral matter have been filled, and by the intrusion of dioritic and other basic and acidic dykes have been further disturbed. A garnet rock, which is present here, has been formed probably from the contact of limestone and granite, and where the limestones and associated sedimentary rocks some distance away from the granite have been disturbed, breccias occur, whose cementing material is limestone.

The limestones at Glen Dee are apparently a continuation of those to the south at Limestone Creek, and those farther away to the south-east in the direction of Mount Alexander.

The garnet rock, the position of which is shown on the accompanying plan, occurs as an outcrop of ironstone near one of the watercourses. As garnet rock in other places is associated with limestone it was thought it might be similarly connected with limestone here. In consequence a search was made, and the presence of limestone was revealed as a limestone breccia on the opposite side of the Dee River. As garnet rock and limestone, together with granitic rocks, are frequently associated with copper, possibly this mineral might also be found by searching for it, especially as the Gympie formation with its altered volcanic tuffs occur not far away. The garnet rock contains traces of gold and silver on the surface, but the weathering action, which has partly changed the garnet rock to an ironstone, would also remove any traces of copper present where the rock outcrops.

The granitic rocks are to the east of the old alluvial workings on the eastern or upper portion of the hill, and also to the north of the hill. A quartz reef in this granite on the higher part of the hill has been prospected by trenches. Its strike is north-north-east and south-south-west, has a varyingly steep underlie, and is about six feet thick. On the surface it is said to have contained gold of high quality, but coated with a film of iron oxide. Another outcrop occurs close to the reef and has a north and south trend, shows a soft ironstone capping, and might be the surface of an intrusive rock rather than that of a lode. Samples were taken for assay, but on testing yielded only traces of gold and silver.

The diorites and other dyke rocks occur on the hills on the opposite side of the river to that on which the old alluvial workings are situated, and are close to the brecciated limestones. The Gympie rocks are to the south of the hill and the flat, and also north in the direction of Struck Oil. The accompanying sketch section (Plate 2) and Plan 3 will show the relations of the different formations at Glen Dee.

(5) CONCLUSIONS.

The time available for the inspection of the mines, and the immediate object in view, precluded much attention being given to the geological features of the various places visited, but sufficient was observed to show that a large amount of data is ready to be recorded in a multitude of places in and around Mount Morgan, which undoubtedly would be of great value when indicating localities where operations should or should not be commenced. At the present time suggestions can only be made from very local observations, and without that confidence which would be felt were a thorough examination of all the surface features to be made and the information obtained accurately mapped.

As there is so much confusion regarding the classification of the rocks of this district, no attempt has been made here to specifically name them. The rocks certainly require a careful microscopical examination, and to attempt to classify such rocks on appearances only is worse than useless. Were they typical forms of igneous rocks, such as granite, aplite, syenite, or diorite, no difficulty would be experienced, but they have been subjected to so much alteration, and have so many modified forms, and show so many changes from one to the other that even a petrological study, to be of use, must be general as well as local.

It is well known that past practices here have not in a single instance availed to show when conditions are favourable or otherwise for stone to carry gold. It is well known that in the Mount Morgan Mine itself it is impossible to tell by appearances whether the stone is rich or poor, as of two samples which might be absolutely the same in texture, colour, structure, specific gravity, and mineral constituents, one would perhaps yield as many ounces of gold to the ton as the other would pennyweights. It is common knowledge that stone from outside the Mount Morgan Mine has been shown to those who are the best judges of what comes from the Mount Morgan stopes, and they have unhesitatingly declared it to be "some of the Linda stone."

Therefore, it may be summed up, if advice is to be given to those who are prospecting in the vicinity of Mount Morgan for the purpose of directing operations, that advice should be given on some thoroughly scientific basis, which can only be achieved by a close study of all the features of the district.

Brisbane, 10th April, 1901.

[No. 161 of the Geological Survey Publications.]

By Authority EDMUND GREGORY, Government Printer, William street, Brisbane.

PLATE 3.—LIGHT OF DAY GOLD MINES—MOUNT GILMORE.

LIGHT OF DAY MINE

MOUNT MORGAN

Plan and Section

OF

WORKINGS

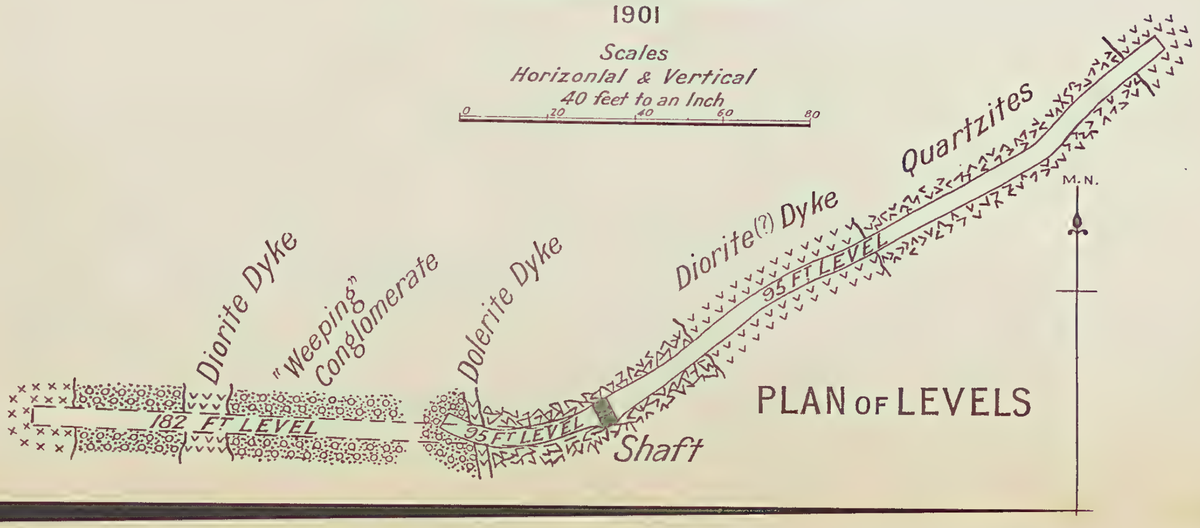
BY

B. DUNSTAN F.G.S.
Assistant Govt Geologist

1901

Scales
Horizontal & Vertical
40 feet to an Inch

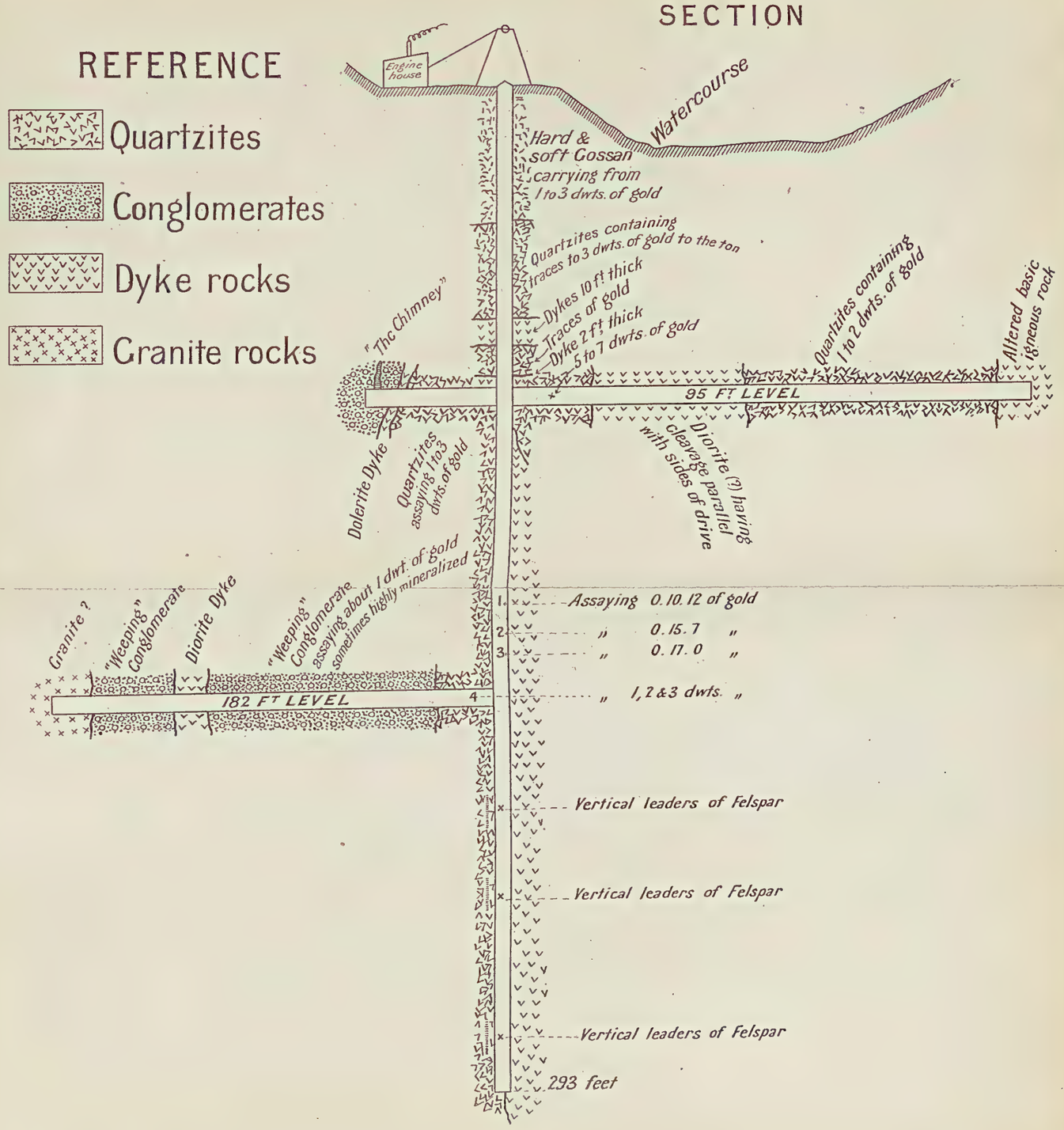
0 20 40 60 80



REFERENCE

- Quartzites
- Conglomerates
- Dyke rocks
- Granite rocks

SECTION


Engine house
Watercourse
Hard & soft Cossan carrying from 1 to 3 dwts. of gold
Quartzites containing traces to 3 dwts. of gold to the ton
Dykes 10 ft thick
Traces of gold
Dyke 2 ft thick
5 to 7 dwts. of gold
"The Chimney"
Quartzites containing 1 to 2 dwts. of gold
Altered basic igneous rock
95 FT LEVEL
Dolerite Dyke
Quartzites assaying 1 to 3 dwts. of gold
Diorite (?) having cleavage parallel with sides of drive
Granite ?
"Weeping" Conglomerate
Diorite Dyke
"Weeping" Conglomerate assaying about 1 dwt. of gold sometimes highly mineralized
182 FT LEVEL
1. Assaying 0.10.12 of gold
2. " 0.15.7 "
3. " 0.17.0 "
4. " 1, 2 & 3 dwts. "
Vertical leaders of Felspar
Vertical leaders of Felspar
Vertical leaders of Felspar
293 feet

NATIONAL MUSEUM, MELBOURNE

HIDDEN TREASURE MINE

MOUNT MORGAN

Plan and Section

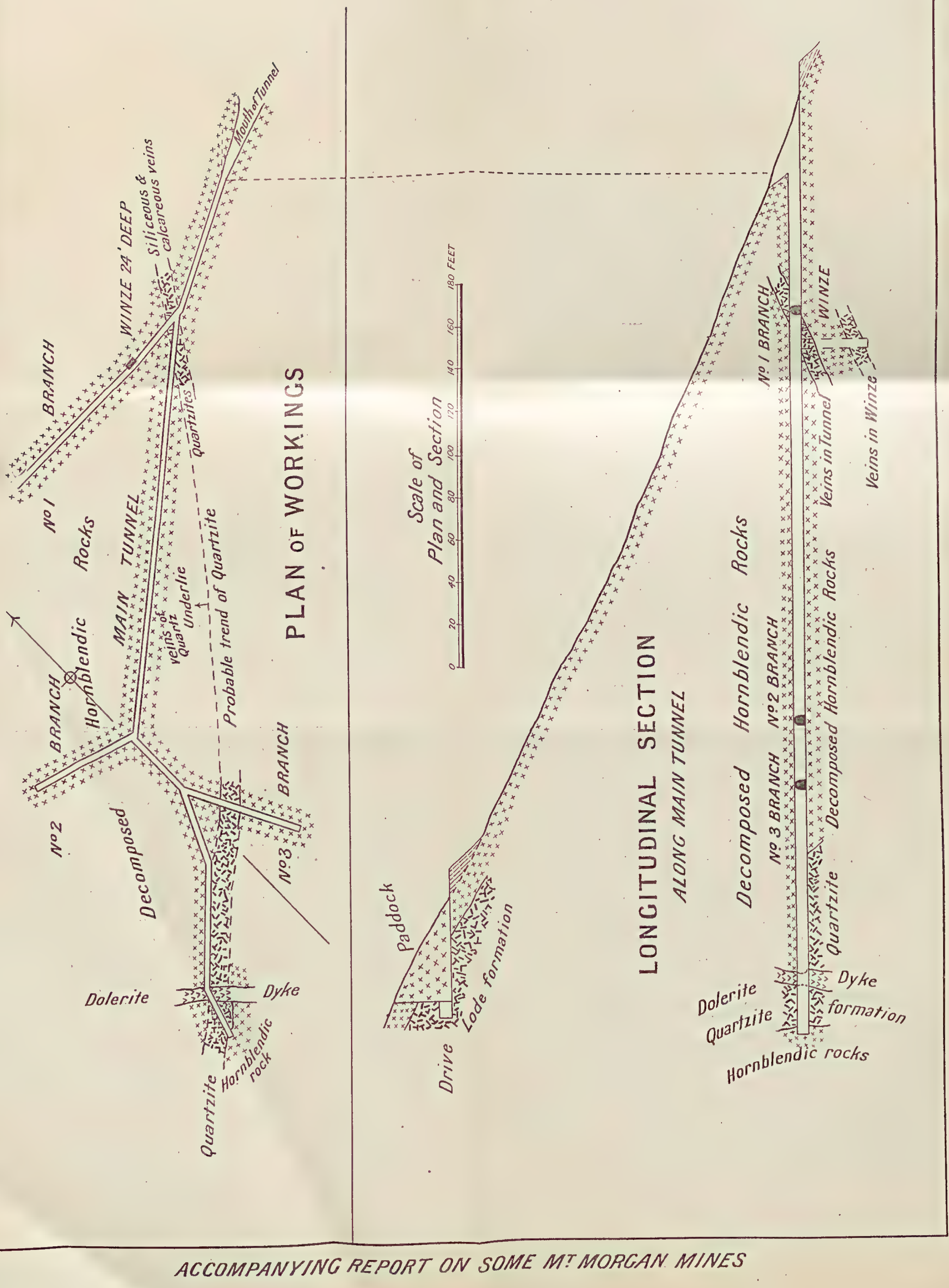
OF

WORKINGS

BY

B. DUNSTAN F.G.S.
Assistant Govt Geologist

1901



ACCOMPANYING REPORT ON SOME Mt MORGAN MINES

NATIONAL MUSEUM MELBOURNE

Geological Sketch Plan OF GLEN DEE NEAR Mt MORGAN

BY

B. DUNSTAN

Assistant Govt Geologist

1901

Scale 0 1/4 1/2 Mile

NOTE:-Geological boundaries only approximate

REFERENCE

- Alluvium
- D Desert Sandstone
- L Limestone
- Di Diorites &c.
- F Cympie rocks
- C Granite

ACCOMPANYING REPORT ON SOME Mt MORGAN MINES

NATIONAL MUSEUM MELBOURNE

Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 16.

REPORT

ON THE

GEOLOGICAL AND MINERAL FEATURES OF DIGLUM CREEK, BARMUNDOO, GLADSTONE DISTRICT;

WITH

REMARKS ON THE PARAGENESIS OF SOME OF THE ROCK-FORMING MINERALS.

By B. DUNSTAN, F.G.S.,
Assistant Government Geologist.

WITH A MAP.

BRISBANE:
BY AUTHORITY: EDMUND GREGORY, GOVERNMENT PRINTER, WILLIAM STREET.

1901.

LETTER OF TRANSMITTAL.

To The Honourable The Minister for Mines.

Geological Survey Office,
Brisbane, 27th April, 1901.

Sir,—

I have the honour to forward herewith Mr. B. Dunstan's Report on the "Geological and Mineral Features of Diglum Creek, Barmundoo, Gladstone District," with a Map, and to recommend that it be published as Bulletin No. 16.

I have, &c.,

WILLIAM H. RANDS,
Government Geologist.

GEOLOGICAL AND MINERAL FEATURES OF DIGLUM CREEK, BARMUNDOO, GLADSTONE DISTRICT.

REPORT ON, BY B. DUNSTAN, F.G.S., ASSISTANT GOVERNMENT GEOLOGIST,

WITH

REMARKS ON THE PARAGENESIS OF SOME OF THE ROCK-FORMING MINERALS.

[With a Map.]

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About twenty-one miles south of Gladstone, and about fourteen miles west of Iveragh Station on the Gladstone-Brisbane Railway Line, the Boyne River is joined by a stream called Futter's Creek. This stream is joined by another called Diglum Creek, the locality where prospecting operations for gold and copper have recently been conducted. The immediate object in view in making the examination of the environs of this creek and its branches was to determine the character of the mineral deposits at the junction of limestones and granite occurring there.

The district generally consists of slates, tuffs, limestones, &c., of Gympie (?) Formation, with occasional outcrops of granite. Just below the junction of the Boyne River and Futter's Creek there is a limestone belt having a north-west and south-east trend, and on the south-western side of this a large development of slate country extends past Barmundoo Station, on Futter's Creek, to Living Creek, one of the principal branches of Diglum Creek.

The slates further west are succeeded by limestone, which has a north-north-westerly trend. The strike of the beds in the individual limestone outcrops is not that of the general trend however, being north and south, while the shape of the outcrops is an indication that the belt has been formed by a combination of a number of successive lenticular-shaped beds partly overlapping one another, a feature better understood by referring to the accompanying map.

The granite of Diglum Creek occurs to the west of the limestones and slates, and is exposed in many of the watercourses. Very little of the granite exposed is undecomposed, most of it being weathered to friable masses, and the action of running water in easily wearing it away has formed steep banks to some of the channels where it is crossed by them.

The presence of this decomposed granite *in situ* in some abundance shows that the rate of its disintegration must be greater than the rate of its removal by surface agencies. This is a matter of some importance when considering the effects of denudation in removing or concentrating gold or other minerals derived from the reefs or lodes which might exist in the neighbourhood.

No indication was seen of intrusive basic rocks in the area examined other than a small dyke of diorite, so it may be assumed that any effects produced in the sedimentary rocks, such as an alteration in their structure or mineral composition or in the formation in them of deposits of metallic minerals, must have been the result of their contact with the granite.

Basalt also is absent in this part of the district, so there is no reason to suppose that recent sedimentary deposits might be in existence in depressions in the older formations, and which might be obscured by flows of this volcanic rock over the surface.

The alluvial deposits are of very limited extent, and are almost exclusively confined to the bed of the main creek.

All the formations referred to above are illustrated in Fig. 1, which shows a sketch section of the country across Diglum Creek and another of its branches, Booreeco Creek, above their confluence. A garnet rock which has been formed close to the granite by the alteration of the limestone is also shown.

MINING OPERATIONS.

Mining operations are confined to the localities where the granite and the slates are separated from one another by limestones, and although the prospecting shafts and trenches do not all show limestone to be present it is always to be found in the vicinity.

Gold has been obtained in a number of places, and by several of the miners who are working on the field it is said to be found in the garnet rock. The recent examination did not confirm this, but the gold which at times has been found in the alluvial of Diglum Creek must have come from some of the formations here, so quite probably the garnet rock contains gold. Assays of this rock also indicate the presence of both gold and silver in traces.

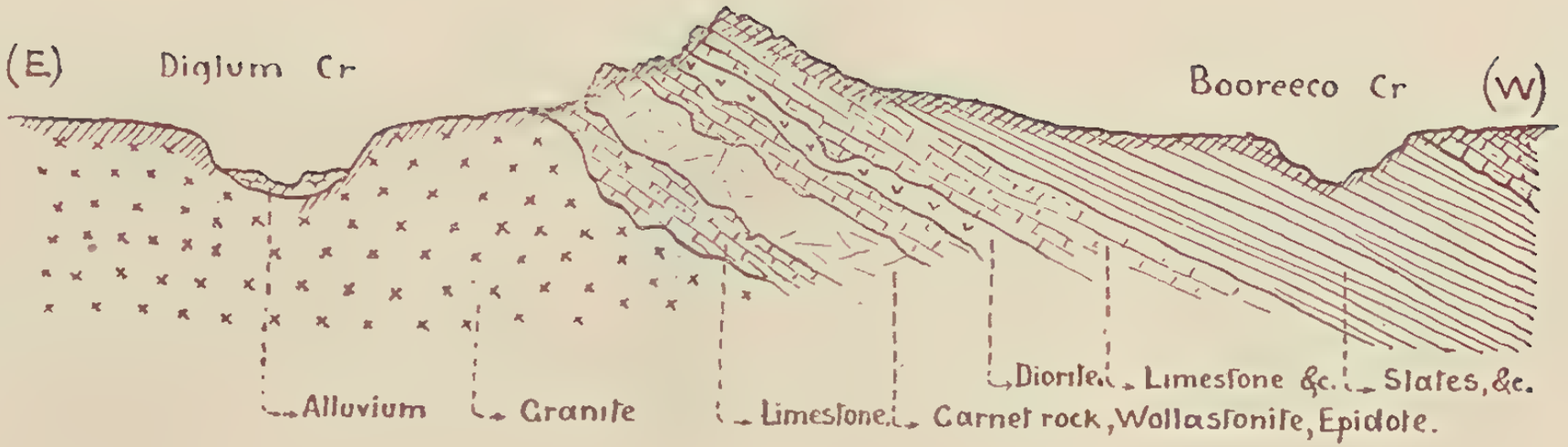
At the workings on the Prospecting Area No. 49 of 160 acres, marked (*a*) on the accompanying map, a trench thirty feet long has been cut through a somewhat granular, partly-decomposed garnet rock. The cracks and joints of the rock contain carbonate of copper but in little more than traces, and there is nothing to indicate in the compact structure of the rock in this particular trench that a much larger amount of copper or other metallic sulphides could have existed here and which might have been oxidized and subsequently removed.

The cap of the garnet rock exposed is very ferruginous in places, and samples taken from all parts of the trench, both at the surface and from the bottom and sides, showed on assay 5 dwt. of silver and traces of gold to the ton.

Another sample of hard stone was taken from an excavation about eight feet square and three feet deep at a distance of about 150 feet south from the trench. This on assay yielded traces of gold and silver, while another sample of soft earthy material from the same excavation gave the same result.

An outcrop of ironstone about sixty feet north-east from the square excavation is, below the surface soil, probably connected with the

Fig. 1.



Sketch Section from Diglum Creek to Booreeco Creek, Barmundoo.

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rocks exposed in the other two workings, and samples taken from here gave similar returns. It may be as well to state that these samples and also others which were taken from the neighbouring mines were made up by chipping small fragments from all the exposed portions of the rocks and from the stone at grass.

Several other outcrops of garnet stone are exposed close to the workings here, but they have not been prospected. A hill to the south-east is composed of limestone, garnet rock, and granite, with the minerals wollastonite and epidote in association with them.

At another Prospecting Area, No. 51, of 160 acres, marked (*b*) on the accompanying map, a trench has been cut across garnet rock. Limestone and altered sedimentary rocks striking north and south occur on the eastern side of this garnet rock, with granite on the western side of it, while a small diorite dyke is exposed in places. The stone contains gold and silver in traces, but there is an absence of indications of copper on the surface.

In the Prospecting Area, No. ?, marked (*c*) on the map, which is on the northern side of Prospecting Area 51, marked (6), garnet rock is being prospected for gold. Traces of copper, as yellow sulphide and blue and green carbonates, are seen close to the surface, and although the miners were quite satisfied that a particular specimen of the stone from here which was examined at the time of the visit contained visible gold, yet the specimen on testing was found to contain only particles of yellow copper sulphide.

In Prospecting Area No. 56, 40 acres, marked (*d*) on the map, the conditions are different to those in the other workings on the field. A shaft, ten feet deep, has been put down on the side of a limestone outcrop, in a mixed formation of quartz, ironstone, and clay. The formation or lode is three feet thick, and exposes a fine show of copper carbonates, the development of which will be interesting to watch as the shaft is sunk deeper. Garnet rock is present here with the limestone, and the lode is evidently a contact deposit formed between these two rocks on the one side and the slates, tuffs, &c., on the other. Assays of the stone show traces of gold and silver, and about 3 per cent. of copper. In the shaft an irregular mass of arsenical pyrites (mispickel) is exposed, a sample of which assayed 4 dwt. of gold and 7 dwt. of silver to the ton.

Close to the out-station of Barmundoo, but on the opposite side of Diglum Creek, at the place marked (*e*) on the accompanying map, an outcrop of garnet rock and limestone contains traces of copper as sulphide and carbonates. The limestones have a north and south strike, and the deposit as a whole generally resembles those at (*a*), (*b*), and (*c*) described above.

From the assay results obtained from the samples from the various workings on the field, nothing of a permanent nature is indicated, and from general observations there is very little encouragement to give to prospecting work here, except at the shaft marked (*a*) on the map, and worked by Mr. Benedict. The presence of the copper here with the gold in the arsenical pyrites close to it shows sufficient inducement to proceed with the work.

It would be quite useless and misleading to state an opinion as to whether the lode at Benedict's Shaft will continue in depth by comparing with similar formations away from here, as the question is one which can only be solved by development. It may, however, be stated that the formations have many features in common with those containing copper at Glassford Creek, particularly in the association of the slates, limestones, garnet rock, and granite, and although most of the prospecting work has not shown successful results, it should not be taken for granted in consequence that similar outcrops in the neighbourhood ought not to be prospected.

APPENDIX.

REMARKS ON THE PARAGENESIS OF SOME OF THE ROCK-FORMING MINERALS.

Where the granite of Diglum Creek is in contact with the limestone, *garnet*, *epidote*, *wollastonite*, and *chert* have been formed, the three former being the products of a combination of the limestone with some of the constituents of the granite, while the chert has been formed by the replacement of the limestone by silica.

The *garnet*, which is the variety *andradite*, a lime-iron silicate, has a crystalline granular structure, and on the surface shows minute cavities evidently once occupied by some easily decomposed mineral.

The *epidote*, the yellowish-green silicate of alumina, lime, and iron, is associated with the garnet, but is intimately mixed with the wollastonite, sometimes ingrained with it, but generally as veins and patches.

The *wollastonite* occurs both as a white compact granular mass, showing fine cleavage faces and as groups of parallel fibres, which, as groups, are either reticulated or are diverging from one another.

The *chert* has not been formed along bedding planes or in any other defined course in the limestone, but in irregular patches and streaks, seemingly without any order or without depending on any structural peculiarity of the limestone for their shape.

All of these minerals represent a series of changes in chemical composition, the basis of which is the carbonate of lime of the sedimentary rock, and the easily decomposed silicates forming the felspar of the granite. The silica resulting from the decomposition of some of these silicates of the felspar in replacing the whole of the carbonates of lime has changed the limestone in places to a chert, and where the silica has combined with the lime and replaced carbonic acid, a silicate of lime has been formed as wollastonite. The presence of ferric oxide as another decomposition product, both from the minerals composing the granite and from other sources, would combine with the lime and silica to form andradite, the lime-iron garnet, and the same constituents with the addition of alumina would form epidote.

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These changes, together with the formulæ showing the composition of the minerals, may be represented thus :—

Silica	SiO_2	*Chert.*
Silica, lime	SiO_2, CaO	*Wollastonite.*
Silica, lime, ferric oxide ...	$3SiO_2$, 3CaO, Fe_2O_3	*Andradite (garnet).*
Silica, lime, ferric oxide, alumina	$6SiO_2$, $3(Al, Fe)_2O_3$, 4CaO, H_2O ...	*Epidote.*

There is some difficulty in determining the order in which the minerals have been formed. From a study of the rocks in section the garnet evidently has been formed before the wollastonite, as crystals of garnet are embedded in the wollastonite. The epidote, in occurring as veins in the same mineral, would seem to have been formed subsequently.

The garnet crystals, however, are to be found in the limestone as well as in the wollastonite, and as the latter rock has been formed by alteration of portions of the former, so, probably, all the garnets have crystallised out before the alteration took place. The epidote also, although occurring as veins traversing the wollastonite, has probably been formed before the alteration from limestone, and so would be older than the wollastonite although apparently of younger growth.

These changes would have the following order :—

1. Alteration of the structure of the sedimentary limestone from compact granular to crystalline granular.
2. Formation of garnet and epidote in the crystalline granular limestone.
3. Alteration of the crystalline limestone to a fibrous and compact wollastonite.

No facts could be established regarding the silicification of the limestones to form chert.

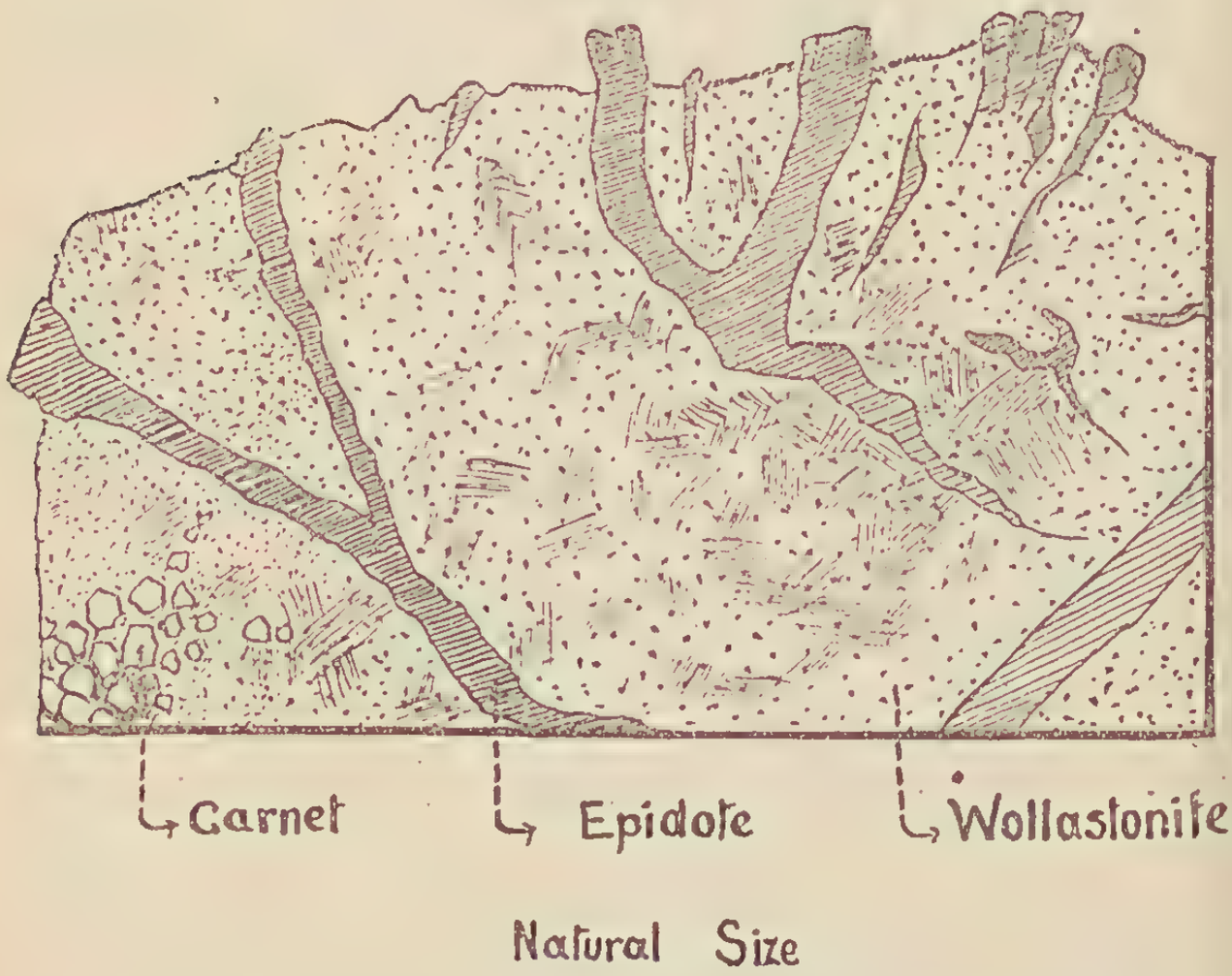
Of metallic minerals there are no data concerning the occurrence of the gold, and with the exception of the presence of the copper pyrites in specks in the garnet rock in one locality, nothing regarding the copper. That copper pyrites occur in the garnet rock there is no doubt, and possibly has segregated out from the tuffs and slates in the vicinity when the other metamorphic changes were taking place. It was observed that the copper occurs more abundantly in the prospecting workings where the limestone and garnet rock are close to the slates and tuffs than where these rocks are absent or some distance away.

Regarding the temperature at which these changes have been brought about, there is nothing to indicate that the granite has intruded the sedimentary rocks. Possibly the reactions have taken place under such conditions of temperature as would be induced simply by the pressure of the sedimentary rocks on the granite before they were weathered down to their present condition.

Of course the limestones in weathering are worn down at a comparatively rapid rate, but only where they have not been altered. The garnet rock where it has a granular texture frets away in grains

like a sandstone, but where massive and crystalline has formed conspicuous iron outcrops. The wollastonite with the epidote occurs as jagged outcrops, but the epidote stands out more prominently than the wollastonite where the two are together, as shown in Fig. 2. This figure also shows the garnet present in the wollastonite.

Fig. 2.



Sketch of Portion of Specimen from Diglum Creek, Barmundoo, showing Crystals of Garnet and Veins of Epidote in Wollastonite.

The wollastonite in weathering away, and the epidote in remaining comparatively little acted upon, might be taken as an illustration of the property of withstanding disintegration possessed by minerals in whose composition the bases are mainly in the form of sesqui-oxides.

Brisbane, 20th April, 1901.

[No. 162 of the Geological Survey Publications.]

By Authority: Edmund Gregory, Government Printer, William street, Brisbane.

GEOLOGICAL SURVEY OF QUEENSLAND

GEOLOGICAL SKETCH MAP

To Illustrate Geological & Mining Notes

ON

BARMUNDOO

Gladstone District

BY

B. DUNSTAN

1901

Scale of Miles

0 1 2 3

Barmundoo Station

Creek

Futter's Creek

Diglum Creek

F

Quartzites

Sandstones

Greywackes

Quartz veins

Iffley Ck.

Slates Tuffs with auriferous Quartz veins

Iffley Ck.

BOUNDARY

GOLDFIELD

Hot

Diglum

Slates &c

Limestones

Slates &c

General strike of Limestones is North & South

Slates &c

Living Creek

F

Granite exposed in watercourse

Creek

Decomposed Granite

Diglum Creek

G

Old Sheep Station

Swamp

Boorecop Creek

Limestones

G

Granite outcrops

F

Decomposed Granite

G

F

Slate country

HIGH RANGES

REFERENCE

Limestones

Slates F

Granite G

Mines referred to in Report (a)

NOTE Geological positions & boundaries only approximate

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Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 17.

REPORT

ON THE

GEOLOGICAL FEATURES OF HAZLEDEAN, WEST OF MACKAY;

WITH

NOTES ON THE COAL, LIMESTONE, AND OTHER MINERAL PRODUCTS OF THE MACKAY DISTRICT.

By B. DUNSTAN, F.G.S.,
Assistant Government Geologist.

WITH A MAP.

BRISBANE:

BY AUTHORITY: GEORGE ARTHUR VAUGHAN, ACTING GOVERNMENT PRINTER, WILLIAM STREET, BRISBANE.

1901.

LETTER OF TRANSMITTAL.

To The Honourable the Minister for Mines.

Geological Survey Office,
Brisbane, 29th May, 1901.

Sir,—

I have the honour to hand you herewith a Report by Mr. B. Dunstan on the "Geological Features of Hazledean, West of Mackay, with Notes on the Coal, Limestone, and other Mineral Products of the Mackay District," and with a Map; and to recommend that the Report be printed as Bulletin No. 17 of the Geological Survey.

I have, &c.,
WILLIAM H. RANDS,
Government Geologist.

GEOLOGICAL FEATURES OF HAZLEDEAN, WEST OF MACKAY.

By B. DUNSTAN, F.G.S., Assistant Government Geologist,

with

Notes on the Coal, Limestone, and other Mineral Products of the Mackay District.

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   (*b*) *Igneous Rocks.*
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3. Mining Operations—
   Gold-mining at Black Waterhole Creek.

4. Coal at Hampden on Constant Creek.

5. Coal at Mount Toby, north of Mirani.

6. Limestone near Mount McGregor, north-east of Mirani.

7. Other Minerals.

INTRODUCTION.

Hazledean is situated on the top of the Range dividing the waters of the Pioneer River, which enters the Pacific Ocean at Mackay, from those of Funnel Creek, a branch of the Isaacs River. The Isaacs River finds its way into the Fitzroy, and this river empties into Keppel Bay.

Hazledean, from Mackay, is about 24 miles directly south-west, but about 35 miles indirectly by rail and road. It is reached by train as far as Eton, and by coach from thence along the Nebo Road.

From Mackay to Eton the country traversed by the railway is slightly undulating and made up of recent alluvial deposits covering Coal Measures. The Coal Measure outcrops occur in many places above the alluvium, and the coal seams which are exposed on the surface have been prospected to a greater or less extent.

The country near the Nebo Road past Eton is in no way difficult to travel over, but at Spencer's Gap, on the Range, the impression is conveyed that engineering difficulties would be encountered should it be found necessary to construct a railway from Eton to Hazledean or any other place on the top of the Range in its vicinity. Whether there are easier means of ascending the Range other than by the Nebo Road cannot be stated, but it is asserted that Cattle Creek offers better facilities for railway construction.

Cattle Creek forms one of the two main branches of the Pioneer River, and has its source near Eungella, due west of Mackay, while Black Waterhole Creek, about which we are more particularly concerned, with other smaller creeks together form the southern branch of the river. These two branches join near Mirani, the western terminus of the Mackay Railway Line.

The steeper portions of the Nebo Road over the Range, or rather what is a spur of the Range, is at Spencer's Gap, the highest part of the Range being on the southern side of Black Waterhole Creek at Hazledean.

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2. GEOLOGICAL FORMATIONS.

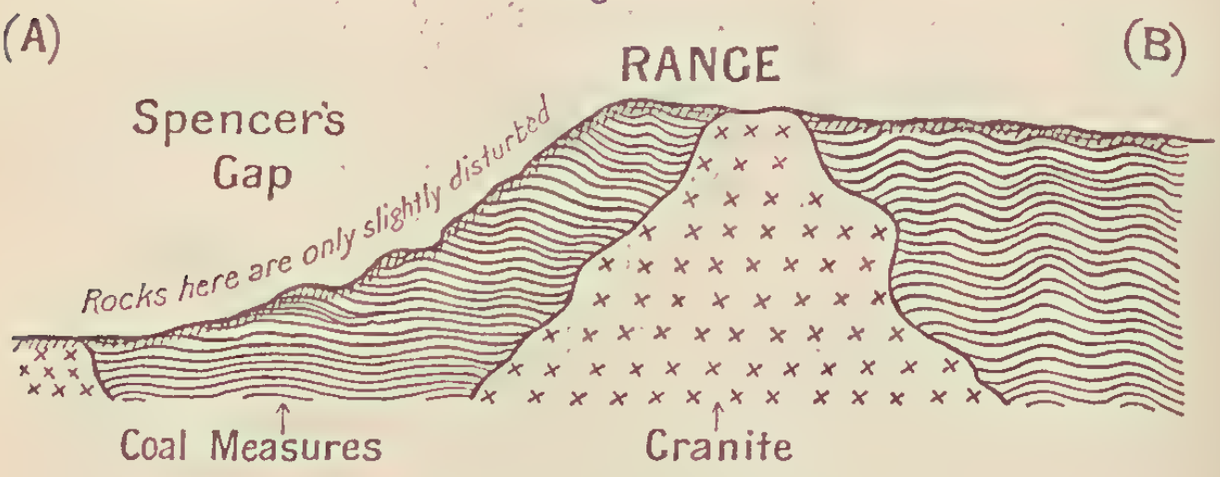
(*a*) Coal Measures.

The oldest sedimentary rocks of the district are Coal Measures, and they are a continuation of a similar formation at Eton, Mirani, and other places nearer Mackay. The difference of altitude between the measures on the top of the range and those below Spencer's Gap was not estimated, but, although great, their general resemblance suggests a close relationship. Granite separates the measures above from those below, and, as this separation continues generally in both northerly and southerly directions for many miles with the same difference in altitude, the eastern side of the granite masses is probably a slope down which the Coal Measures on the coast side have been faulted. Were there no change in their relative positions since they were laid down as sediment, the beds at the base of the Coal Measures at the head of Black Waterhole Creek would not be found at their present elevation so far above those at the bottom of the range.

The Coal Measures on the range have a general westerly inclination. Where they are close to the granite at Spencer's Gap and at the heads of Black Waterhole Creek, they are remarkably uniform and almost horizontal, while near Hazledean Hotel *away* from igneous rocks they are crumpled and much disturbed.

A section is shown in Fig. 1 along a north and south line—A.B. on accompanying map—at Spencer's Gap, illustrating the Coal Measures and the granite masses associated with them. If a fault exists at all, it will be to the north of the granite shown on the left of the section.

Fig. 1.



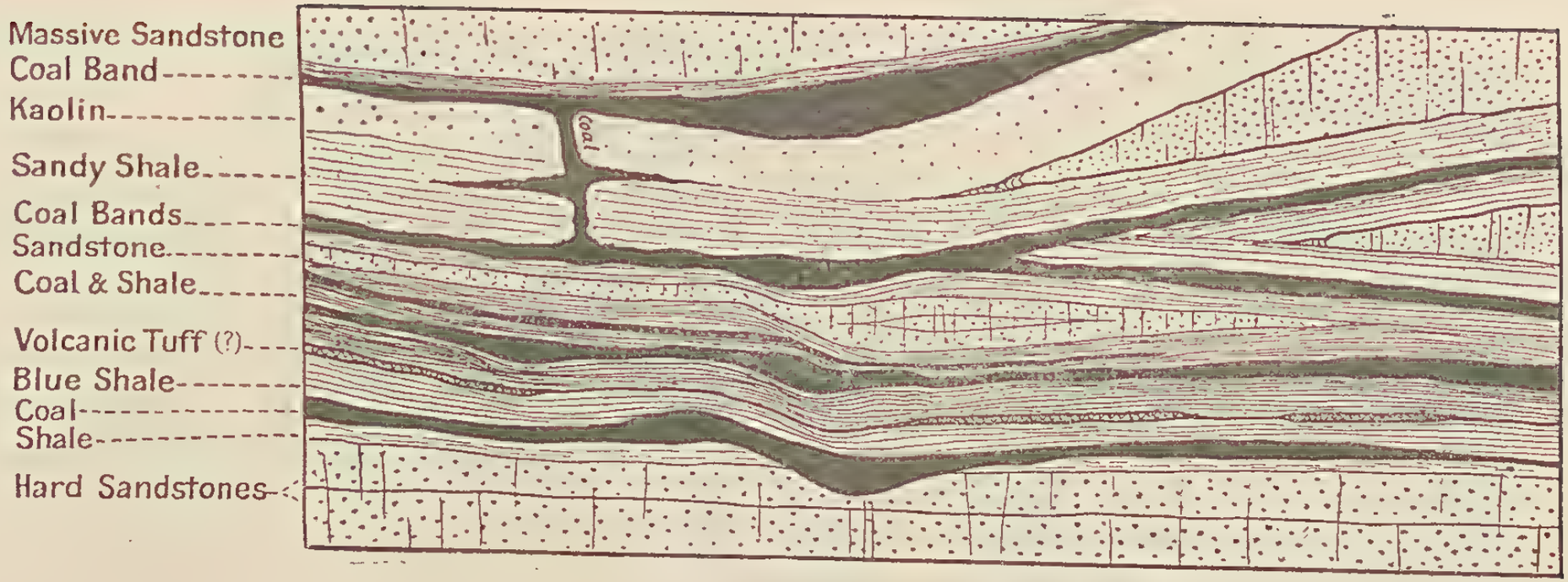
Sketch Section along the Eton-Nebo Road.

On a line A.B. shown on accompanying Map.

At Hazledean, a large development of Coal Measures is exposed. On Black Waterhole Creek, west of Hazledean Hotel, bands of coal with shales and sandstones outcrop in the cliff sections, and show many interesting features. There is great irregularity in their structure and foldings, and in one spot some coal bands which are interbedded with sandy shales have a vertical *vein* of coal joining them together.

At the same place there is evidence of erosion and movement during deposition, and two bands which are joined together to form a single band might be the result of the partial removal of the overburden or the result of partial subsidence at the time they were being deposited. These features are illustrated in Fig. 2.

Fig. 2.



NATURAL SECTION AT BLACK WATERHOLE CREEK, BELOW HAZLEDEAN.

Showing the arrangement of the Coal Bands.

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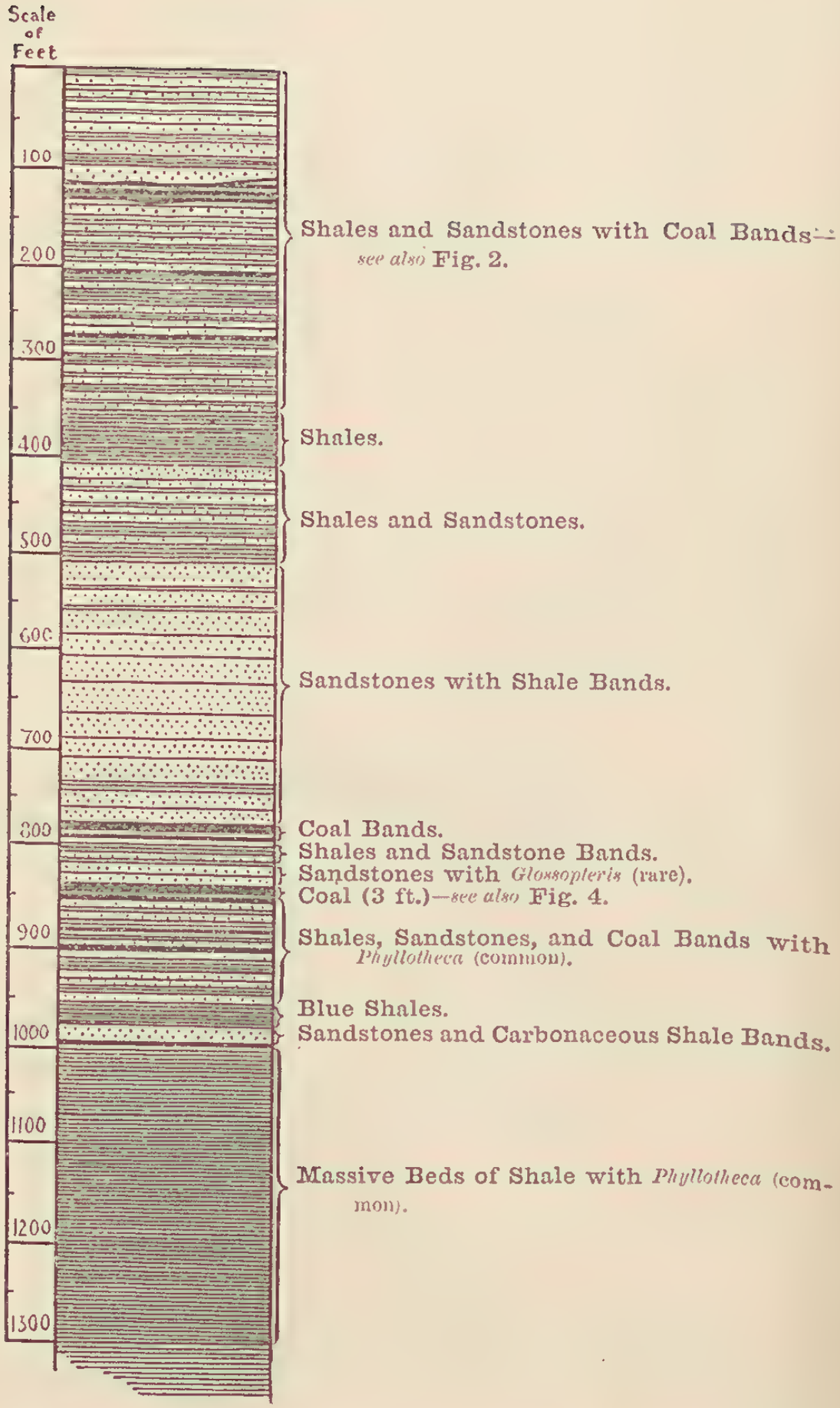
Fig. 3.



Section of Rocks exposed in Black Waterhole Creek, Hazledean.

Above Hazledean, the rocks of Black Waterhole Creek are well exposed and have a general westerly dip, but varies from a horizontal position to being nearly vertical. An examination was made of all the exposures along the bed of the creek, and, from the sections measured, it is calculated that the thickness of the Coal Measures here is over 1,200 feet. They comprise shales, sandstones, calcareous sandstones, carbonaceous shales, and bands and seams of coal. The shales are frequently fossiliferous, containing *Phyllotheca* and *Glossopteris*—the former in abundance, the latter very rarely. The coal seams are exposed on the banks of the stream, but unweathered samples could not be obtained, so their quality could not be determined. Some of the bands of coal have not been weathered very much, however, and contain a very large percentage of ash. Possibly other coal bands which are disintegrated where exposed might have been so changed, because they contain a less percentage of ash, and so might be of better quality if prospected at a depth away from atmospheric action.

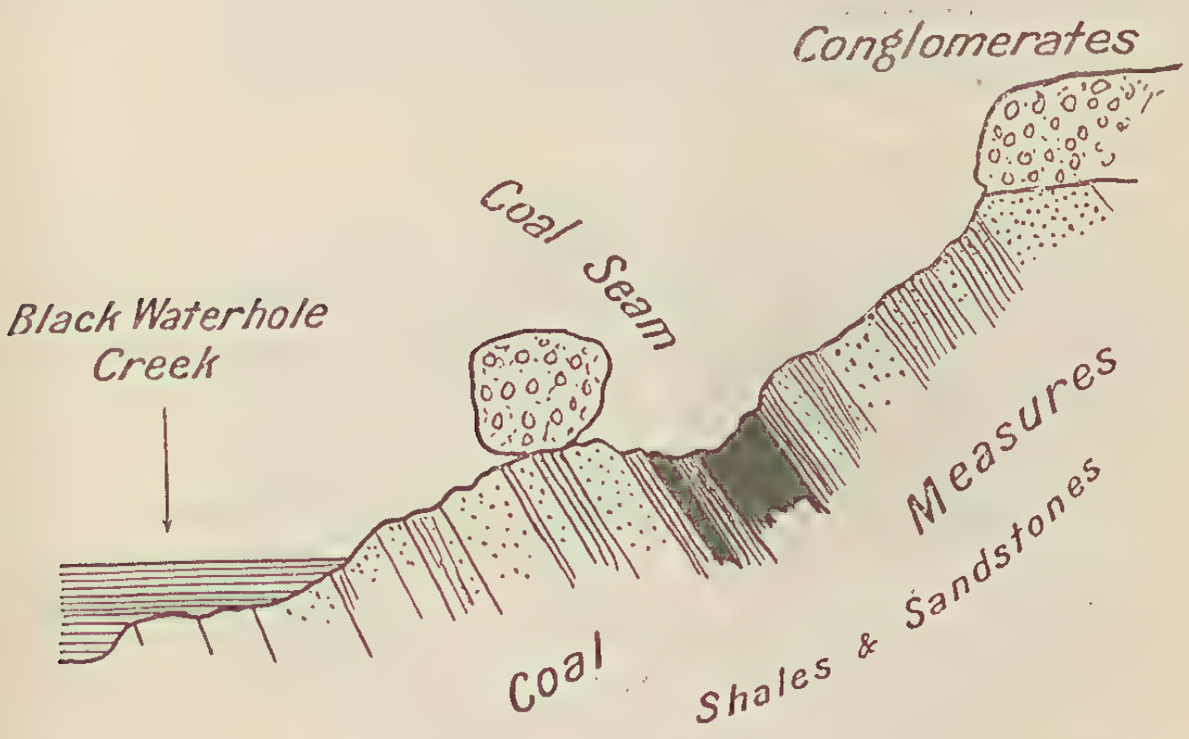
Fig. 3 is an illustration of a section of the rocks measured from (C) to (D)—marked on the accompanying map—on Black Waterhole Creek.

The rocks in this section are faulted, but the faults are not severe or numerous.

The thickness of the coal seams in every case is not an encouraging feature, as of all the seams examined none, so far as the surface indications show, are over three feet thick.

The following sketch section, Fig. 4, is taken from Black Waterhole Creek, and shows the outcrop and inclination of a coal seam three feet thick, and also an unconformable capping of a more recent conglomerate above it:—

Fig. 4.



NATURAL SECTION IN BLACK WATERHOLE CREEK, ABOVE HAZLEDEAN HOTEL.

Showing a Coal Seam, the Inclination of the Rocks, and the Capping of Conglomerate.

Further up this creek there is an almost continuous exposure of the rocks at the base of the section shown in Fig. 2 to where they come in contact with granite. They contain abundance of *Phyllotheca*, and occasionally also *Glossopteris*. At the head of Kemmis Creek, a branch of Black Waterhole Creek, coal seams are exposed high up close to the granite which outcrops here on the Range, but they are similar to those lower down near Hazledean Hotel.

The total thickness of the Coal Measures of Hazledean is altogether over 1,700 feet, and includes the 1,200 feet of measured section illustrated in Fig. 3, and the rocks higher up the stream which, from what was observed, may be taken to be about 500 feet.

The rocks of Hazledean have received some previous consideration from Dr. Jack and Mr. Maitland in their reports on the Mackay District,* both of whom examined portions of this part of the district.

The age of the sedimentary rocks was given as "Carbonifero-Permian" by Mr. Maitland in 1889,† and on an accompanying map in his Progress Report for the same year they are shown as "Lower Bowen," a subdivision of this Formation. On the last edition (1899) of the Geological Map of Queensland, however, they have been thrown into confusion, some of the strata being placed as "Gympie," other portions as "Upper Bowen," and the rest as "Lower Bowen." No geological work has been carried out since Mr. Maitland's examination until recently, and no reason can be found to alter them from the position he assigned them to, particularly those which are wrongly shown on the Geological Map as "Gympie" Formation, since the beds are unquestionably of freshwater origin. The work of the writer on the Dawson and Mackenzie Rivers, taken in conjunction with recent work in the Mackay District, would tend to show that the Mackay Coal Measures generally are the equivalents of the Lower Freshwater (B) Series of the Lower Bowen Formation‡ not only from the occurrence of anthracitic coal in them and from their general lithological appearance, but because of the presence of marine limestones on the coast islands to the east of them of probably Gympie Age.

(*b*) Igneous Rocks.

Granite.—Where the Coal Measures are close to the granite on the Range at the heads of Black Waterhole and Kemmis Creeks, they are intruded by dykes of this rock and diorite. On one line of such intrusion, as well as these igneous rocks there are veins of auriferous quartz. The dykes associated with the quartz veins are nearly all decomposed, and where they are close to the veins are auriferous.

The granite of the Range continues westerly across the Nebo Road at the top of Spencer's Gap, and thence north-westerly to connect with other similar outcrops.

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* 1. "Report on the Geological Features of the Mackay District."—R.L.J. By Authority: Brisbane, 1887, p. 1, G.S.Q. 39.

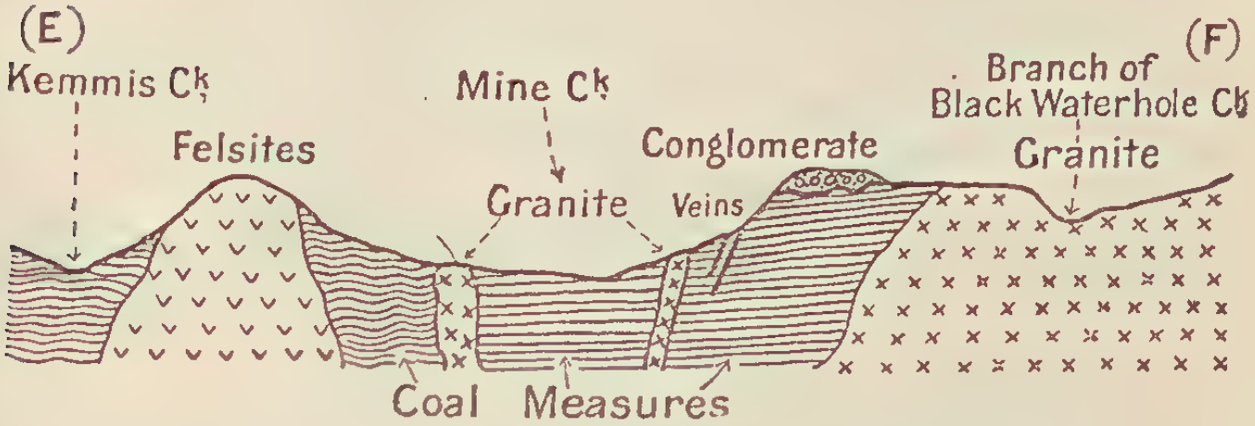
2. "Geological Features and Mineral Resources of the Mackay District."—By A.G.M. By Authority: Brisbane, 1889, pp. 6-8, G.S.Q. 53.

† *Ibid.*, p. 4.

‡ The Geology of the Dawson and Mackenzie Rivers. Brisbane: By Authority, 1901; G.S.Q., 155; Table on p. 23.

Felsite.—This rock forms large masses associated with the Coal Measures, but whether of prior or subsequent formation to them could not be ascertained. It is shown in Fig. 5, which is a sketch section between Kemmis Creek and Mine Creek, together with the Coal Measures, the position of the auriferous veins, and the granite dykes and masses.

Fig. 5.



Sketch Section along Line E.F. on Accompanying Map.

Showing the Felsites, Granite, Coal Measures, and Auriferous Veins.
Length of Section, about 1¾ miles.

Diorites.—Both the granite and diorite dykes are closely connected with the auriferous veins of Mine Creek, and reference has just been made to the presence of gold where they are in contact with the quartz veins. This applies especially to the diorites. In the shingle of Black Waterhole Creek near Mine Creek, boulders of the diorite together with dolerite, rhyolite, and felsites are to be found, an indication of the character of the rocks higher up the stream.

Aplite also occurs in the gold workings of Mine Creek in association with a partly decomposed chloritic rock. As the workings were inaccessible, the relation of the aplite to the surrounding rocks could not be ascertained.

(*c*) Conglomerates.

The conglomerates have been referred to previously in connection with the Coal Measures over which they unconformably rest. In Fig. 4 is shown the manner in which they occur at Black Waterhole Creek, although in some places they are stratigraphically conformable with, instead of resting on the tilted edges of the older rocks.

It is evident from their appearance on either side of Black Waterhole Creek that at one time the conglomerates have extensively covered the Coal Measures. Their present position around Hazledean suggests this, but since that time they have been partly removed. The creek has cut a channel completely through them, and exposed the Coal Measures below with the conglomerates resting on them.

They contain no fossil remains, and there is no evidence as to their age, although they partake of the character of the "Desert Sandstone" Formation.

(*d*) Alluvial Deposits.

Alluvial deposits are of very limited extent in the watercourses about Hazledean, but where they occur at the heads of the creeks, and where the Coal Measures are in contact with the granite, they always contain gold. It is only at Mine Creek, however, that they have been found to contain gold in payable quantities, and then only in small patches.

In the vicinity of Hazledean the banks and bed of Black Waterhole Creek contain magnetite as a black sand, probably derived from the altered sedimentary and igneous rocks at the head of the creek.

A small watercourse immediately to the south of Hazledean Hotel contains a recently formed freshwater limestone deposit, but it is of limited extent and mixed up very much with débris. Zircons and garnets occur in the branches of Black Waterhole Creek with the alluvial gold.

3. MINING OPERATIONS.

Gold-Mining at Black Waterhole Creek.

While there has been no attempt made by prospectors to determine the character and quality of the coal seams of Black Waterhole Creek, the gold deposits have received considerable attention.

Operations in prospecting for gold were started by testing the watercourses of Mine Creek. This was succeeded by the discovery of the sources of the gold in the veins and leaders in the vicinity. Later on some prospecting trenches, shafts, and drives were made to test the veins and leaders, and also the dykes with which they are associated. It is in connection with these prospecting workings—the workings of P.A. 70 and 72—that an examination was made of the gold-bearing formations.

In P.A. 70 some old shafts and underlie workings show that the place has received some attention previously, but with what results could not be ascertained. The present workings consist of open-cuts, shafts, and shallow trenches, and a considerable amount of prospecting work has been accomplished. The extreme north-west workings consist of an open-cut 60 feet long, made on the course of an auriferous vein of quartz, clay, and ironstone, and good prospects can be obtained from almost any part of it. Gold has been dollied from the stone from here bythe prospectors, and also from other parts of this and the adjoining mine (P.A. 72), the evidence of which is in the heaps of crushed stone near Mine Creek. The persistence of the prospectors in staying on the field year after year shows that they must be getting some gold, otherwise it would be abandoned.

A trench has been cut across this vein, exposing a formation seven feet wide. This formation also carries gold, although only in traces judging from the results of testing the samples stripped from the sides of the trench.

To the south-east of these workings, a tunnel 15 feet long has been driven to the north-east, in the sides of the hill near the level of the creek. This was to cut a small vein which at some previous time was worked above from the outcrop, but no definite results accrued from the work. It would seem that the vein, in not appearing in the

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face of the tunnel, is of irregular occurrence, and that possibly it has pinched out just below the surface. Trenches to the east and west of the tunnel show the presence of a small quartzose vein, from which good prospects of gold can be obtained, but from the stone exposed in other parts of the trenches, or on the walls of the veins, or in a decomposed dyke rock on the south-eastern side of the drive only traces of gold could be detected. The decomposed dyke is two feet wide in places, but is very irregular, and isolated masses of it are surrounded, on the exposed face, by sedimentary rocks.

Further to the south-east, a distance of about 200 feet, a vertical shaft has been sunk, and also an underlie shaft to the north of this, and although the gold can be found in the leaders here, yet samples which were taken from the stone at grass and said to be auriferous contained only traces of gold. A picked sample from a narrow dyke of decomposed basic rock contained gold at the rate of half-an-ounce to the ton.

A lode of mispickel (arsenical pyrites) occurs on this same property on the western side of Mine Creek. It extends from near the creek up to the top of the ridge separating this creek from Kemmis Creek. Samples were obtained from various parts of the outcrop, and showed traces of gold and silver.

In P.A. 72, to the south-east of P.A. 70, the workings consist of shafts, trenches, and a tunnel. On the outcrop of the gold-bearing stone, near the top of the hill, shafts and trenches have been made to explore a number of small veins along a general east and west course, while some distance below the outcrop a tunnel has been driven to strike the same formation in depth.

A shaft near the junction boundary of P.A. 70 and P.A. 72 has been sunk on clayey leaders having an east and west trend. The leaders and also the partings in the horizontal bedding planes of the shales, &c., forming the walls, contain gold, but a sample stripped across a face of the formation, said to carry gold also, only indicated traces of this metal. It is just possible that the gold in the leaders and partings would pay to work by themselves, but there would be no doubt about it if the stone around them contained gold as well, even if only in small quantities.

To the east of this shaft, at a distance of about 160 feet, an underlie shaft about 65 feet deep has been sunk. Open cuts have been made east and west of this shaft to take out a rich, small vein. On the surface the gold-bearing stone is clayey, but at 40 feet a quartz vein was met with, associated with an intrusion of aplite, and below this some local disturbance has evidently taken place. The underlie of the auriferous formation is to the south, and a vertical shaft, at a distance of 50 feet south from the underlie shaft, was sunk to a depth of 30 feet without obtaining any satisfactory results.

Samples were taken from all of the workings accessible, and, while the narrow veins show gold, the formation they are in invariably contains traces.

The tunnel put in the side of the hill below the outcrop has been driven 131 feet through horizontally bedded Coal Measure rocks, but no leaders or veins carrying gold have been met with.

The accompanying sketch section, Fig. 6, will show the position of this tunnel with relation to the vertical and underlie shafts and to the auriferous formation underlying to the south.

It would have been preferable to prospect the formation by following it down the underlie before putting in a tunnel, but, as the work in the latter place has proceeded so far, perhaps it would be better to continue it about 50 feet further to find out if the veins are to be met with or disappear in depth, and finally to determine if there is sufficient encouragement to warrant more work being expended on it, or whether it would be better to stop operations.

Regarding the other workings, the unsatisfactory nature of the results obtained from the testing of the samples will not allow of much encouragement being given to further prospect them, even with the gold occurring in the leaders and veins. Even a few pennyweights of gold in the formation containing the veins would be sufficient to make the mine payable, but all the tests which were made showed only traces.

It may be noted that a carbonate of bismuth occurs in several of the workings, and locally is called "snowy," and wherever this is found the miners say they can always obtain gold either in the veins or in the adjoining decomposed dyke rocks.

Yellow copper pyrites is also occasionally found in the veins, and is looked upon by the miners as a good indication of the presence of the gold.

4. COAL AT HAMPDEN ON CONSTANT CREEK.

Hampden is situated about 20 miles north-west from Mackay, on the coast road to Bowen, at the crossing of Constant Creek.

Reference has been made to this part of the Mackay District by Dr. Jack and Mr. Maitland in the reports previously quoted, and therein the Coal Measures at Constant Creek have been mentioned.

The sedimentary formations in the vicinity of Hampden have been considerably disturbed by intrusive rocks, and the Coal Measures which exist here have been contorted and faulted by these dykes where they have been penetrated by them.

A shaft has been sunk near Mr. Millard's house to prospect an outcrop of coal which had been exposed when sinking a well. This shaft has been sunk to 67 feet through several bands and three seams of coal of varying qualities.

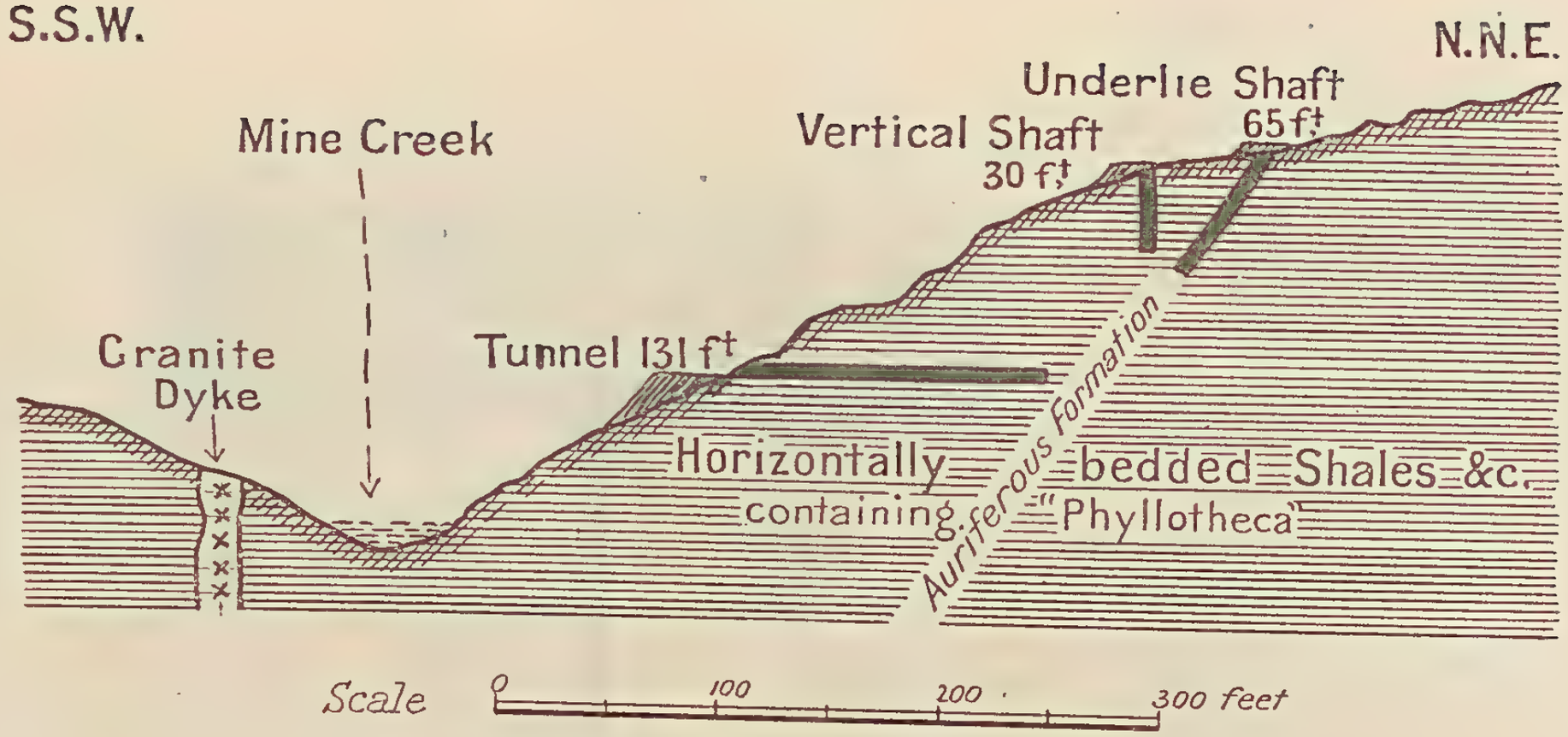
The first coal seam was penetrated at 16 feet, and contains two feet of an inferior anthracite, the analysis of which is as follows:—

ANALYSIS OF HAMPDEN INFERIOR ANTHRACITE.

Moisture	2·4 per cent.
Volatile hydrocarbons	2·2 „
Fixed carbon	65·8 „
Ash	29·6 „

A part of this seam is of better quality than the other portion, and is about 6 inches in thickness. An analysis of this shows a higher percentage of carbon and a lower percentage of ash than the rest of the seam.

Fig. 6.



SECTION ACROSS THE COAL MEASURES, MINE CREEK.

Showing the Granite Dyke, Auriferous Formation, and Mine Workings.

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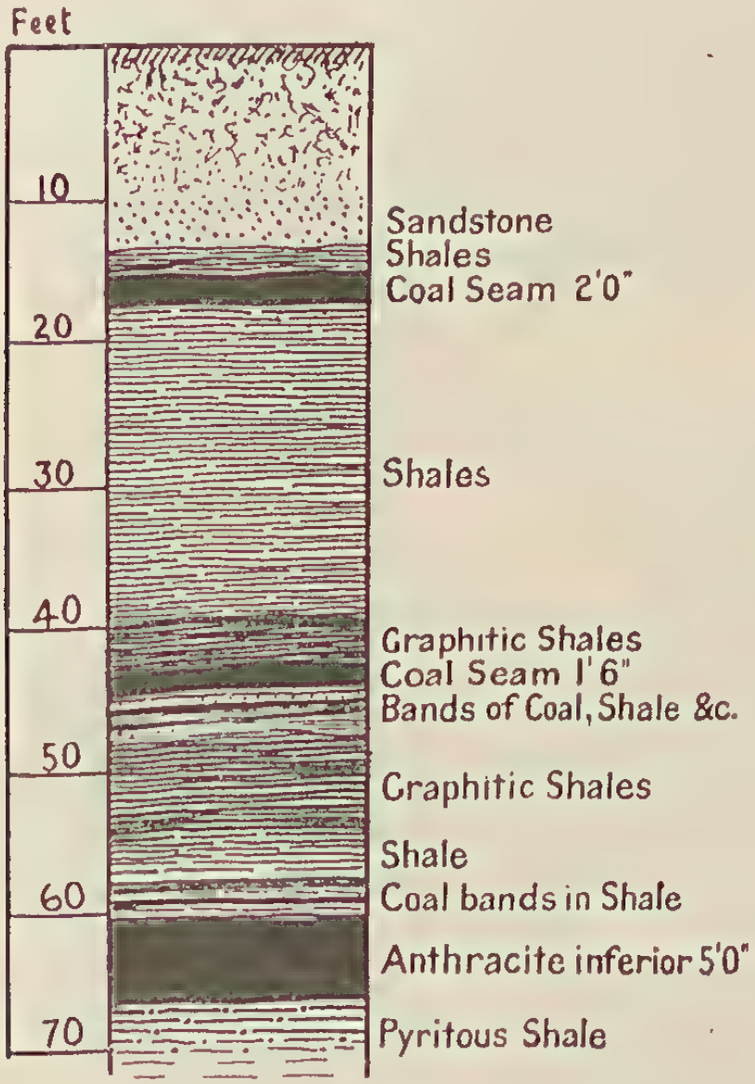
ANALYSIS OF SIX-INCH SEAM, HAMPDEN.

Moisture	2·36 per cent.
Volatile hydrocarbons	5·00 „
Fixed carbon	71·10 „
Ash	21·54 „

Below this seam much of the shale is carbonaceous, with joints in is lined with graphite. It is only recently that the lowest seam of coal was penetrated, and the quality of this, on the whole, is about the same at that higher up in the shaft, although the seam is much thicker.

The following section, Fig. 7, of the strata penetrated in the shaft shows three distinct coal seams, all of which are anthracitic, but inferior in quality :—

Fig. 7.



SECTION OF STRATA AT HAMPDEN SHAFT.

As the finding of a good coal seam in this district would be of inestimable value, it certainly is advisable to prospect the measures more to the north-west where they are not so much crumpled and disturbed. In this direction from Hampden there are miles of country apparently unbroken by intrusions of igneous rocks, and as the coal is known to occur in several places the attention of prospectors

should be concentrated there. Coal has been found on Murray, St. Helen's, and Black Rock Creeks, and these localities should receive special attention.

The shipping facilities of Mackay are well known, but the deep-water harbour of Port Newry has received very little attention. In the event of workable coal being found, Port Newry would be of great advantage as a shipping port, as it is close to the Coal Measures.

5. COAL AT MOUNT TOBY.

Mount Toby is about 4½ miles north of the railway terminus of Mirani. Its geological features have been described by Mr. Maitland in his report on the Mackay District, previously referred to, and details are given therein on its general characters.

Discoveries of coal have been made since then in some of the outcrops of Coal Measures on the sides of the mountain, and a little prospecting work has revealed the thickness of the seams. The seams examined at the recent visit were high up on the mountain above Mr. Roach's house, but they are said to crop out on the other side of the mountain also. The sections have exposed the coal as small unworkable seams of undoubtedly good quality, as seen in the following analysis, and also in a thicker seam of an inferior quality containing too much ash to be of any use:—

ANALYSIS OF COAL AT MOUNT TOBY.

Moisture	6·3 per cent.
Vol. hydrocarbons	31·3 „
Fixed carbon	51·8 „
Ash	7·6 „

Where the coal occurs, the rocks are being worn away by the action of water falling down the precipitous sides of the mountain, and fresh faces are constantly being formed, and consequently what is seen on the surface can be taken as a criterion of what might be expected by further prospecting. At the same time, other portions of the Coal Measures below the horizon of these coal outcrops might contain good coal of workable thickness, and it is here where further exploratory work should be directed.

Basalt boulders are found in the ravines leading down from the mountain, from which it is surmised that the mountain has been pierced by a basalt dyke, or has been covered at one time by a protecting sheet of this rock.

6. LIMESTONE DEPOSITS NEAR MOUNT McGREGOR.

Mount McGregor lies to the north-east of Mount Toby, on the northern side of the Pioneer River, and to the north-north-east of the Mirani Railway Station. The rocks exposed on the sides of the mountains are Coal Measures more or less disturbed by intrusions of both acidic and basic igneous rocks. The basic rocks are generally

decomposed where they are exposed, and veins of calcite, laumonite, and chalcedony traverse them in all directions. Finely banded agates are common in the rock cavities, and also on the surface where the rocks are being weathered away.

Subsequent to the decomposition of the rocks which contain the calcite, denudation has removed portions of them to form alluvial deposits at lower levels in the vicinity, and these deposits contain more or less carbonate of lime.

On selections 958 and 930 these alluvial deposits have been exploited by sinking shafts in a number of places, and the results of the work prove that the deposits exist over a large area. Their occurrence is extremely irregular, as may be judged from their being formed as comparatively recent deposits in the depressions and hollows of the older rocks which outcrop in the vicinity, but in some of them there is a large percentage of carbonate of lime.

They resemble very closely other alluvial deposits in containing gravel and sand and débris of various kinds, but they contain only a small percentage of clay. A fine white substance, very much like the fine white pipeclay (kaolin) so often found in such deposits, on testing, was found to be nearly pure carbonate of lime. The following analysis, made by Mr. Henderson, the Government Analyst, of a sample submitted to him by me and taken from a shaft about 20 feet deep, shows the average percentage of the carbonate of lime, together with the other constituents composing it:—

ANALYSIS OF LIMESTONE FROM NEAR MOUNT MCGREGOR.

Silica	19·88 per cent.
Carbonate of lime	71·00 „
Iron and alumina	3·06 „
Carbonate of magnesia	0·76 „

The workings in the neighbourhood on similar deposits were at the time of the inspection all submerged by flood-water, so they could not be examined to determine if they are of better or inferior quality.

To prove whether the limestone deposits are extensive or not further prospecting work is necessary, and with such good results from the sample tested it would be advisable to proceed with this work. Care must be taken to have the material tested at every step. The quality will be liable to great fluctuations, and the deposits can hardly be expected to be of the regular character of the old bedded marine limestones of the rocks of Permo-Carboniferous or Devonian Age, such as those of Repulse Island, close to the coast.

The stone is not in a good condition for burning in the ordinary kilns on account of its friability, and possibly a difficulty will be experienced in doing this.

Regarding the uses to which it might be applied, its adaptability for agricultural purposes has been practically demonstrated locally, and its general adoption for this can be looked forward to. As a neutralising reagent in sugar manufacture its suitability has yet to be demonstrated, so for this purpose it should be tried.

7. OTHER MINERALS.

STRONTIANITE (carbonate of strontia).—A specimen said to come from a vein in the rocks at the old Bowen Crossing of the Pioneer River, near Mirani, was examined and found to be strontianite. As strontia is preferable to lime in some chemical operations on account of the less solubility of its compounds, possibly this mineral substance would be better than lime in sugar manufacture.

STRONTIANO-CALCITE (carbonate of lime and strontia).—From a small vein in one of the cuttings on the tramway line on Mr. Edward's Selection, near Mount Toby, a sample of calcite was taken. A portion of this gives strontia reactions, and appears to be strontiano-calcite.

PLEONASTE (a black variety of spinel ruby).—This mineral is found in the alluvial workings of the Mount Britton Gold Field. It occurs as crystals in the form of *triakis octohedron* and *octohedron*, all the faces of which are curved. The black colour, the curved faces of the crystals, and in being hard enough to scratch quartz, have given the impression that they are black diamonds.

GRAPHITE.—A deposit of this occurs at Homebush, near Mackay. It does not appear to be of a first-class quality, but there is a large deposit of it, and which could be easily opened out to see if the quality improves where it is not so much exposed to surface influences.

Brisbane, 22nd May, 1901.

[No. 164 of the Geological Survey Publications.]

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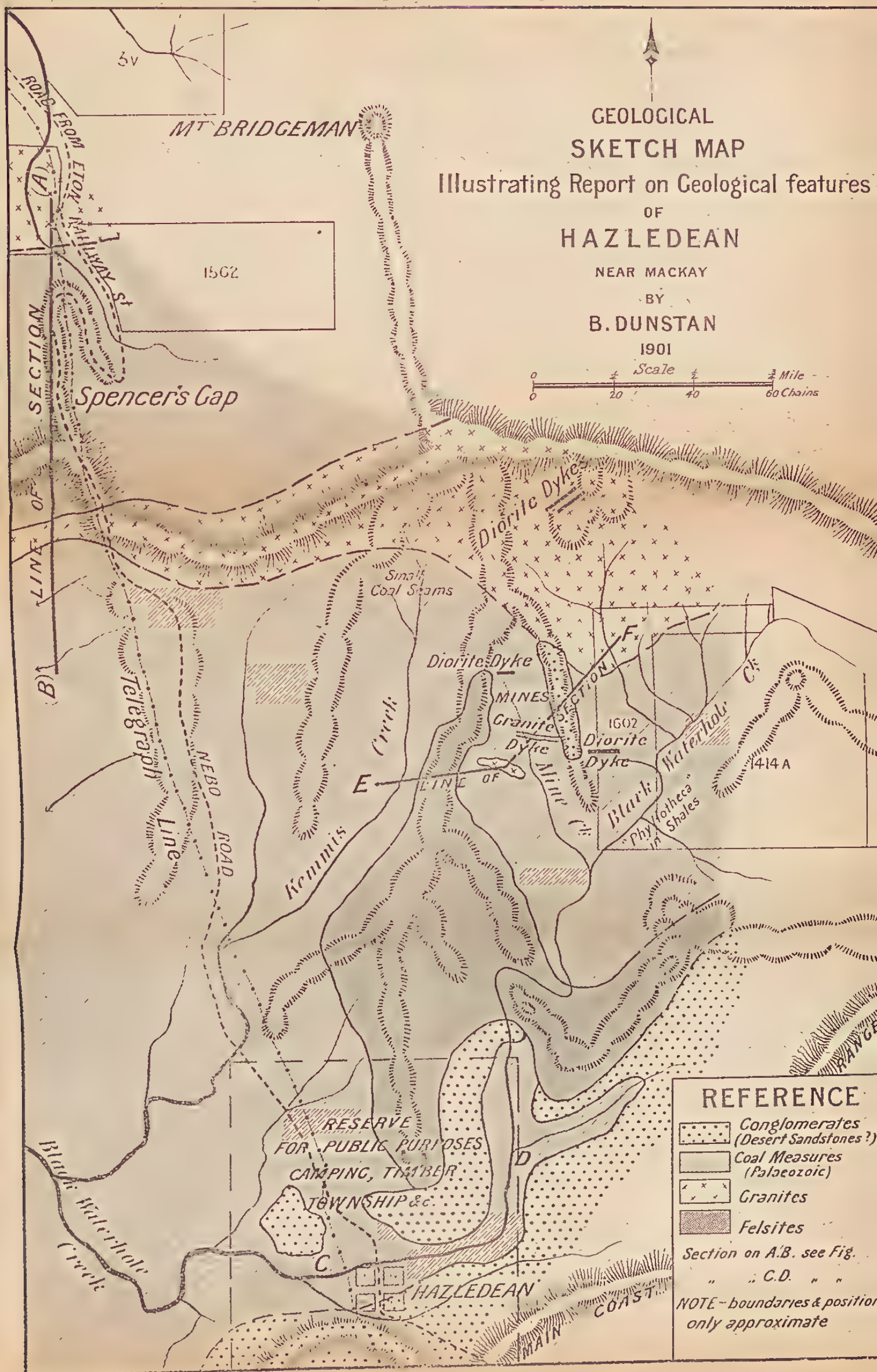
GEOLOGICAL
SKETCH MAP
Illustrating Report on Geological features
OF
HAZLEDEAN
NEAR MACKAY
BY
B. DUNSTAN
1901
Scale
0 ¼ ½ ¾ Mile
0 20 40 60 Chains
Mt BRIDGEMAN
ROAD FROM ETON RAILWAY St
1562
SECTION
LINE OF
Spencer's Cap
Diorite Dyke
Small Coal Seams
Diorite Dyke
MINES
Granite
Dyke
Diorite Dyke
1602
Waterhole Ck
1414 A
Black Phyllotheca Shales
E Creek
Kennis
Telegraph Line
NEBO ROAD
RESERVE
FOR PUBLIC PURPOSES
CAMPING, TIMBER
TOWNSHIP &c.
HAZLEDEAN
MAIN COAST
Black Waterhole Creek
REFERENCE
Conglomerates (Desert Sandstones?)
Coal Measures (Palaeozoic)
Granites
Felsites
Section on A.B. see Fig.
" " C.D. " "
NOTE - boundaries & position only approximate

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Queensland.

DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 18.

NOTES

ON

FOSSIL PLANTS FROM DUARINGA, IPSWICH, DAWSON RIVER, AND STANWELL

(WITH EIGHT PLATES);

AND ON

FOSSIL WOODS FROM THE IPSWICH BEDS, BOGGO ROAD, BRISBANE.

(WITH THREE PLATES.)

NATIONAL MUSEUM MELBOURNE

BY JOHN SHIRLEY, B.Sc., LOND.

Consulting Palæobotanist.

BRISBANE:

BY AUTHORITY: GEORGE ARTHUR VAUGHAN, GOVERNMENT PRINTER, WILLIAM STREET.

1902.

LETTER OF TRANSMITTAL.

To The Honourable The Minister for Mines.

Geological Survey Office,
Brisbane, 22nd January, 1902.

Sir,—

I have the honour to forward herewith Notes on Fossil Plants from Duaringa, Ipswich, Dawson River, and Stanwell (with eight Plates); and on Fossil Woods from the Ipswich Beds, Boggo road, Brisbane (with three Plates), by Mr. John Shirley, B.Sc.; and to recommend that they be printed as Bulletin No. 18 of the Geological Survey.

I have, &c.,

WILLIAM H. RANDS,
Government Geologist.

FOSSIL PLANTS FROM DUARINGA, IPSWICH, DAWSON RIVER, AND STANWELL.

INTRODUCTION.

The plant-fossils which form the subject of this paper were collected by Mr. B. Dunstan, Assistant Government Geologist. They illustrate mainly the floras of the coal measures, both Palæozoic and Mesozoic.

The Palæozoic coal-fossils were obtained from the basin of the Dawson River, in strata of Middle and of Upper Bowen age. Plants of this age belong mainly to the ferns, especially to the families Glossopteris and Sphenopteris.

The most interesting plant is a fragment of a Sphenopteris with fertile fronds. Outwardly, and as far as careful comparison can serve, the general appearance of this fruiting specimen points to Mertensia as the proper title for the various Queensland fossil species at present classified under Sphenopteris. This decision cannot be regarded as final until silicified fruiting fragments are found that still retain the elements of original structure, and permit of section-cutting and definite examination under the microscope.

The Mesozoic coal-fossils were obtained from beds belonging to the Ipswich formation, partly at Stanwell on the Central Railway, 16 miles west of Rockhampton, and a few from Denmark Hill, near the town of Ipswich, on the Southern and Western Railway, 26 miles west of Brisbane.

Beds of this age have been more carefully searched for fossil plants, and have yielded a richer store of species than those of any other Queensland formation. The most interesting additions to our Mesozoic coal-flora are: (1) A species of Palissya, and (2) an Oleandridium of very remarkable form. The Palissya shows faint traces, in rare instances, of the peculiar braid-like casts of the fertile shoots. The Oleandridium has such a very long petiole, and such a narrow spear-shaped blade to the frond, that the specific name *jaculi* has been applied to it. From Denmark Hill the most important find is a Pecopteris, bearing a very remarkable resemblance to P. Mantelli, as figured in Lindley and Hutton, II., 145.

In addition to the coal-fossils, there are a few plant forms obtained by Mr. Dunstan from the Duaringa bore, on the Central Railway, 66 miles west of Rockhampton. These plants are of doubtful age. Mr. Dunstan, in his report on the "Geology of the Dawson and Mackenzie Rivers, with special reference to the occurrence of Anthracitic Coal," pp. 20, 22, and 23, refers these beds doubtfully to the "? Tertiary, ? Lacustrine Series"; but the few fossil plants they yielded gave little basis for determination, though, on the whole, they have rather a Cretaceous than a Tertiary aspect.

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FOSSIL PLANTS FROM DUARINGA, IPSWICH, DAWSON RIVER, AND STANWELL.

By JOHN SHIRLEY, B.Sc. (Lond.).

Division **PHANEROGAMIA**, *Linn.*

Class **DICOTYLEDONES**, *Ray.*

Sub-class POLYPETALÆ. Series MAGNOLIALES.

Order **MAGNOLIACEÆ.**

Genus MAGNOLIA.

1. **Magnolia ?** No. 33. A well-marked but imperfect specimen, showing a well-defined midvein; a few primary veins, parallel, and arising from the midrib at an angle of about 60 degrees; the polygonal meshes; and the smaller polygons of the tertiaries.

Locality—Duaringa Bore, Upper Cretaceous Beds?

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Sub-class MONOCHLAMYDEÆ. Series UNISEXUALES.

Order **URTICACEÆ.**

Genus FICUS, *Linn.*

2. **Ficus subgœpperti,** sp. nov. No. 32. A mere fragment, but excellently preserved, showing a portion of the midvein, with several of the primaries, which are joined parallel with the margin by strongly marked looping veins, the interspaces between the primaries divided into a fine network of meshed veins. This leaf closely resembles F. Gœpperti, *Eth.*, Schimper II., 730, and Plate XC., Fig. 9, which is, however, of Tertiary age. Plate I.

Locality—Duaringa Bore, Upper Cretaceous Beds?

3. **Ficus ?** No. 34. This leaf has a strong midvein, from 6 to 8 primaries on each side, alternate, and looped near the margin; intermediate secondary veins parallel to and midway between the primaries, meshing with the latter, and with still finer veinlets in polygons, whose long axes point to margin and midvein, and with still finer meshes filling in the spaces of the polygons before mentioned.

Locality—Duaringa Bore, Upper Cretaceous Beds?

Sub-class GYMNOSPERMÆ.

Order CONIFERÆ.

Sub-order ABIETINEÆ.

Genus PALISSYA, *Endlicher.*

4. **Palissya gracilis**, sp. nov. Nos. 10 (in part), 21 (in part) 22 (in part), 26 (in part).—A short, sterile branch, the stem marked by the decurrent lines from the base of the crowded leaves. Leaves linear, to 1 inch long by 1 line wide, acute, with a single central vein. The lower leaves are patent, the upper ones more erect, especially at the summit. This may be the *Taxites medius* of Rev. Tenison-Woods, but the insertion of the leaves is wholly dissimilar from that of Taxites, there being no narrowing to meet the stem; the leaves are widest at their insertion, at which point they show, under pressure, peculiar sinuses. Plate II.

Locality—Stewart's Creek, Stanwell, Ipswich Beds; Trias-Jura Formation.

Order CYCADEÆ, *Rich.*

Genus PTILOPHYLLUM, *Morris.*

5. **PTILOPHYLLUM** oligoneuron, *Ten. Woods.* No. 9. Feistmantel, "Coal and Plant Bearing Beds of Eastern Australia and Tasmania," p. 149.

Tenison-Woods, Proc. Linn, Soc., N. S. Wales, 1883, Vol. VIII. p. 113, Pl. 7, figs. 2, 3, 4.

Locality—Stewart's Creek, Stanwell, Ipswich Beds; Trias-Jura Formation.

Genus ZEUGOPHYLLITES, *Brong.*

6. **Zeugophyllites elongatus** (*Feist.*) *Morr.* Nos. 21 and 22 (in part). Feistmantel, "Coal and Plant Bearing Beds of Eastern Australia and Tasmania," p. 150, Pl. XXI, Figs. 6 and 6 (a).

Locality—Stewart's Creek, Stanwell, Ipswich Beds; Trias-Jura Formation.

Genus NŒGGERATHIA, *Steinberg.*

7. **Nœggerathia?** No. 7. This is a most interesting fossil, and, at first sight, the leaves might be taken for the shells of bivalves. The leaves are 1 in. wide, and ½ in. from apex to base, reniform in shape, sessile, very thick and coriaceous, the apex broadly obtuse, strongly concave on its upper surface and convex below. The veins are parallel, and fork two or three times near the margin. Were it not that occasionally a leaf shows its attachment to the stem, the character of this fossil would remain in doubt. The venation is usually hidden by mineral infiltrations between the veins, giving a false appearance of numerous anastomoses. Plate IV.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen; Permo-Carboniferous.

Genus CYCADOSPERMUM, *Saporta.*

8. **Cycadospermum Dawsoni**, sp. nov. Nos. 29, 30, 31.

Seed ovoid, $1\frac{1}{4}$ in. by $\frac{3}{4}$ in., varying considerably in the relative dimensions of length and breadth, base truncate or cordate; each seed is usually marked by a median furrow, and the apex is usually shortly cleft, but both these characters may be due to pressure. The surface is occasionally marked by a mesh of veins, forming narrow polygons, the longest diameter of each polygon pointing to apex and base. This probably marks the remains of the endocarp. Plate III.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen; Permo-Carboniferous.

Sub-class CORDAITÆ.

Order CORDAITES, *Unger.*

Genus CORDAISPERMUM, *Brong.*

9. **Cordaianthus** comp. **Lindleyi**, *Carr.* No. 4 (in part). Renault I., p. 95, Pl. XIII., Fig. 9.

Locality—Denmark Hill, Ipswich Beds; Trias-Jura Formation.

Division.- CRYPTOGAMIA, *Linn.*

Class PTERIDOPHYTA.

Order MARSILIACEÆ.

Genus MARSILEA, *Linn.*

10. **Marsilea?** Nos. 35 and 36. These fruits (?) may possibly be the sporocarps of a Marsilea, similar to those of the modern Marsilea Drummondi, which are gathered by Australian aborigines, and eaten as Nardoo. Under the microscope they show traces of a number of cavities, some containing numerous small cells, which may possibly be the microspores of Marsilea.

Locality—Duaringa Bore, Upper Cretaceous?

Order FILICES.

I.—Filicaceæ certæ sedis systematicæ.

Family SCHIZÆACEÆ.

Genus MERTENSIA, *Willd.*

11. **Mertensia lobifolia**, sp. nov.; s. Sphenopteris lobifolia, *Morr.* No. 14 (b).

Strzelecki's Phy. Descr. N. S. Wales, 1845, p. 246, t. 7, figs. 3 and 3 (a).

This fruiting specimen, although a mere fragment, is of the highest importance, as shedding some light on the Sphenopteris alata, S. lobifolia, S. flexuosa, and S. crebra series of Permo-Carboniferous forms. From a consideration of the Dawson River fossils, I am strongly of opinion that these forms merely exhibit differences in pinnæ from one and the same species of fern, representing different portions or stages of growth of the frond. At present the critical points distinguishing these so-called species are :—

S. alata, *Stern.* Rhachis smooth, marginate-alate, pinnule lobes two on each side, with a terminal tri-lobed one.

S. lobifolia, *Morris.* Rhachis not alate, pinnules with three lobes on each side, and the usual tri-lobed terminal one.

S. flexuosa, *McCoy.* Rhachis naked, flexuose, pinnules as in S. alata; veins strong, much branched.

S. crebra, *Ten. Woods.* Rhachis naked; pinnules crowded, and almost entire.

The fruiting specimen probably belongs to the so-called S. lobifolia, *Morris.* The fructifications are in masses on the first fork of the primary veins of each pinnule, there being one sorus for each lobe; and, as in Gleichenia their modern allies, the margins of the lobes seem to have been recurved. Those existing forms, the umbrella ferns of Queensland, may thus be the dwindling descendants of the so-called Sphenopteris species of Permo-Carboniferous times; just as our two solitary species, Angiopteris evecta and Marattia fraxinea, may be the descendants of the numerous Tæniopterideæ of Mesozoic age. Plate V.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen; Permo-Carboniferous.

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Family OSMUNDEÆ.

Genus TODEA, *Willd.*

12. **Todea australis**, *Renault*; s. **Alethopteris australis**, *Morris.* Nos. 23 (in part), 24 (f), 25 (in part). Renault, III., p. 81, Pl. III. Shirley, Additions to the Fossil Flora of Queensland, p. 17.

Locality—Stewart's Creek, Stanwell, Ipswich Beds; Trias-Jura Formation.

II.—Filicaceæ incertæ sedis systematicæ.

Family SPHENOPTERIDEÆ.

13. **Sphenopteris crebra**, *Ten. Woods.* Nos. 2 (in part), 11 (in part). Ten. Woods, Proc. Lin. Soc., New South Wales, VIII., Pt. 1, p. 57 (reprint), Pl. 3, Fig. 4.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen, Permo-Carboniferous Formation.

14. **Sphenopteris flexuosa**, *McCoy*, No. 6. Ann. and Mag. of Nat. Hist., 1847, p. 150, t. 9, Figs. 4 and 4 (a).

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen, Permo-Carboniferous Formation.

15. Sphenopteris alata, *Sternberg*; s. Ovopteris alata, *Potonié*. Nos. 11 (in part) and 18. Flor. Rothliegenden v. Thuringen, Abhand. K. Preuss. Geol. Landesanst. n. folge, Heft. 9, Th. 2, 1893, p. 44.

Dun:—Records of the Geological Survey of New South Wales, Vol. VI., Part 1, p. 48, Pl. VI., Fig. 1.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen; Permo-Carboniferous Formation.

Family NEUROPTERIDEÆ.

Genus NEUROPTERIS, *Brong.*

16. Neuropteris punctata, *Shirley*. Nos. 20 and 28 (in part). The specimen figured shows the apex of a frond, and with Plate XIV., fig. 2., and the letterpress on p. 20, Add. Fos. Fl. Queensland, enables us to obtain a fairly clear idea of the outlines of this fern. Plate VII.

Locality—Denmark Hill, Ipswich Beds; Trias-Jura Formation.

Family LOMATOPTERIDEÆ.

Genus THINNFELDIA, *Ettingshausen.*

17. Thinnfeldia indica, *Feist.* Nos. 10, 21, 22, 24 (a), 26 (all in part).

Pal. Ind. (Gondwana Flora), 1877, 1, 2, Plate XXXIX., Figs. 1 and 1 (a), Pl. XLVI., Figs. 1 and 2 (a).

Shirley, Additions to the Fossil Flora of Queensland, pp. 20 and 21, Pl. VI., Fig. 2, Pl. VII., Fig. 2.

18. Thinnfeldia odontopteroides, *Morris.* Nos. 25, 26, 27 (all in part).

Feistmantel, Pal. Ind. (Gondwana Flora), 1879, 1, Pt. 4, p. 201; 1881, III., Fas. 3, p. 85, t. 23 (a), f. 7-9.

Locality—Stewart's Creek, Stanwell, Ipswich Beds; Trias-Jura Formation.

Family PECOPTERIDEÆ.

Genus PECOPTERIS, *Brong.*

19. Pecopteris comp. Manteli, *Brong.* No. 25 (in part), Brongniart, Hist. des Veg. Foss., I., 278, t. 83, Figs. 3 and 4.

Lindley and Hutton, II., 145.

At first sight this might be taken for a fragment of a Taxites or Palissya, but the lens shows the well-known pecopteroid venation. The fragment is from the apical portion of a frond, simply pinnate, the pinnæ linear, to ½ in. long, by one line wide; the costa of each pinna is firmly marked, and there are numerous primary veins running at angles of 15 degrees to 60 degrees to the margins. The apices of the pinnæ are not shown, nor is the bipinnate portion of the frond represented as in Lindley and Hutton's figure. Plate VI.

Locality—Denmark Hill, Ipswich Beds; Trias-Jura Formation.

Family TÆNIOPTERIDEÆ.

20. **Tæniopteris Etheridgei**, *Shirley*. Additions to the Fossil Flora of Queensland, p. 23, Pl. IX., Fig. 1.

On further examination of this plant, from material obtained at Denmark Hill, Ipswich, it proves to be identical with Oleandridium lentriculiforme, *Eth. fils.*, and the name T. Etheridgei must therefore lapse.

21. **Tæniopteris spatulata**, *McClelland*. No. 26 (in part).

McClelland, Pal. Ind. Fossil Flora of Rajmahal, Series 2, Pt. 1, Plate VI.

Shirley, *loc. cit.*, p. 23.

Locality—Stewart's Creek, Stanwell, Ipswich Beds; Trias-Jura Formation.

Genus OLEANDRIDIUM, *Schimper*.

22. **Oleandridium lentriculiforme**, *Eth. fils*. Nos. 3, 16, 23, 26, 27 (all in part).

Etheridge, Rec. Geol. Sur. N. S. Wales, Vol. IV., Pt. II., p. 49, Plate VIII., Figs. 1, 2, 3.

Shirley *loc. cit.*, p. 24, Plate VII., Fig. 3, and Pl. IX., Fig. 1, under Tæniopteris Etheridgei.

Locality—Denmark Hill, Ipswich Beds; Trias-Jura Formation.

23. **Oleandridium jaculi**, sp. nov. No. 10 (in part). Leaf simple (?), 4-6 inches long, 2-4 lines broad, the blade taking up rather less than $\frac{5}{6}$ of the total length, the petiole rather more than $\frac{1}{6}$. The blade is falcate, very graceful in outline, and slightly tapering to the apex, but the tip is always somewhat obtuse. The costa is strongly marked, the veins are numerous, arising almost at right angles to the costa, simple, or forking once close to the midrib. The base of the petiole shows a kind of pulvinus. Plate VIII.

Locality—Stewart's Creek, Stanwell, Ipswich Beds; Trias-Jura Formation.

Family DICTYOPTERIDEÆ.

Genus GLOSSOPTERIS, *Brong*.

24. **Glossopteris Browniana**, *Brong*. Nos. 11, 15, 17, 19 (all in part).

Brong. Hist. Veg. Foss. 1828, p. 223, t. 62.

Etheridge, Geol. of Queens. and New Guinea, p. 193, Pl. XVI., 6, 8; Pl. XVII., 9, 10.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen; Permo-Carboniferous Formation.

25. **Glossopteris Browniana v. praecursor**, *Feist*. No. 8 (in part). Feist., Coal and Plant Bearing Beds of Eastern Australia and Tasmania, p. 122, Pl. XIII., Figs. 5-7.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen; Permo-Carboniferous Formation.

26. Glossopteris Browniana v. australasica, *Brong.* Feistmantel, *loc. cit.* p. 121, Pl. XVI., Fig. 3.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen ; Permo-Carboniferous Formation.

27. Glossopteris communis, *Feist.* Nos. 15, 17, 19 (all in part). Feistmantel, Gondwana Series, 1881, Vol. III., Pt. 2, p. 98.

Feistmantel, Coal and Plant Bearing Beds of E. Australia and Tasmania, p. 123, Pl. XVII., Figs. 2, 6.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen ; Permo-Carboniferous Formation.

28. Glossopteris parallela, *Feist.* No. 14 (a) (in part). Feistmantel, Coal and Plant Bearing Beds of E. Australia and Tasmania, p. 126, Pl. XVIII., Figs. 2, 3, 4.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen ; Permo-Carboniferous Formation.

29. Glossopteris elegans, *Feist.* No. 19 (in part). Feistmantel, *loc. cit.* p. 124, Pl. XII., Figs. 3 and 3 (a).

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen ; Permo-Carboniferous Formation.

30. Glossopteris Wilkinsoni, *Feist.* Nos. 15, 17 (in part). Feistmantel, *loc. cit.* p. 128, Pl. XX., Figs. 1 and 1 (a).

This plant has all the appearance of a Tæniopteris, except that the primary veins, which usually arise singly, and are parallel through the greater part of their course, anastomose near the margins. The resemblance to T. Daintreei is striking ; but the costa is very broad, and there is a peculiarity about the base of the blade which suggests that it was perfoliate.

Locality—Dawson River, Anthracitic (B) Series, Lower Bowen ; Permo-Carboniferous Formation.

Order CALAMARIEÆ.

Genus CALAMOCLADUS, *Schimper.*

31. Calamocladus ? No. 28 (in part).

Locality—Denmark Hill, Ipswich Beds ; Trias-Jura Formation.

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FOSSIL WOODS FROM THE IPSWICH BEDS, BOGGO ROAD, BRISBANE.

The following information was supplied by Mr. L. C. Green, by whom the fossil woods were collected:—

"The fossil woods, which you have examined all came from the same place, which is a cutting near the South Brisbane Cemetery, on Boggo Road. To my mind the rock belongs to the volcanic *tuff*. The trees lie in a horizontal position at base, parallel with the bedding, which is well marked. The *tuff* here is not very thick—from memory, I should say about 6 feet—and it is interbedded between sandstone. In this case, as in many others around Brisbane, the *tuff* has a small thickness of Ipswich beds below it."

From Mr. Green's statements it may be inferred that the trees grew and flourished during the times when the Ipswich beds formed a land surface covered with luxuriant vegetation, and that their vegetable structure was intact when they were buried under the volcanic ash.

Order CONIFERÆ.

Taxoxylon Philpii, *sp. nov.*

(No. I., three slides, showing transverse, radial, and tangential sections. No. VII., three slides, all transverse sections.)

(*a*) The transverse section shows the woody tissue to consist solely of tracheides or spindle-shaped wood-cells, without vessels, or resin cells, or resin cavities. In this transverse aspect the cut ends of the tracheides appear square or oblong, the largest being ·0022 in. by ·00138 in.; occasionally they are polygonal, but rarely so. Sections of the bordered pits may be noted, but in very few cases is the torus intact. The medullary rays consist of a single row of cells. The annual zones of wood are very distinctly marked, the narrow thick-walled autumn cells forming a distinct division between the larger and thin-walled cells of adjoining annual summer zones. Whether from pressure or from mode of growth certain lines of cells are confused and irregular. [Plate IX.]

(*b*) The longitudinal section shows the wood to consist of fusiform tracheides, the ends overlapping, an arrangement produced by what is known as creeping growth. The walls of the cells are marked by spiral thickenings, one set dextrorsal, the other sinistrorsal. These spiral strands look like flat bands, the greatest width of any one band being ·00035 in. Bordered cells are rarely preserved, but in a few cases they may be seen between the spires of the strengthening layers of the cells. [Plate X.]

(*c*) The tangential section does not reveal any additional features, the sections of the medullary rays being very indistinct. [Plate XI.]

NOTE 1.—This is the first fossil wood of the yew section of the pine family which has so far been discovered in Queensland.

NOTE 2.—Renault, Vol. IV., p. 204, in a table showing the appearance of each genus of the Coniferæ in geological sequence, gives the Upper Carboniferous beds as the site of the earliest Taxoxylon. There is then an immense gap in the record of the genus, unbroken until Eocene times. The Queensland fossil helps to bridge this gap.

NOTE 3.—The only living yews of Australasia are the genera Phyllocladus, Dacrydium, and Phaerosphæra of Tasmania.

Araucarioxylon?

This fossil is closely allied to A. Randsii, but as the coarse grinding of the sections has destroyed much of the structure, it is impossible to determine exactly. (Specimens II., III., and VI., three sections each—transverse, longitudinal, and tangential).

(*a*) The transverse section shows a very contorted condition of the rows of cells. The medullary rays are numerous, of a single row of cells. The annual zones are very distinct. On account of the contortion of tissue, it is very difficult to ascertain the dimensions of the cut ends of tracheides.

(*b*) The longitudinal section shows very slender tracheides, ·0042 in. by ·0003 in.; but all bordered pits have been destroyed by the coarse grinding material employed.

(*c*) The tangential section shows lenticular-shaped cuttings through the medullary rays, in which the cells are single-ranked, and thirteen to twenty in number. Very rarely the bordered pits may be seen in one or two rows, in the latter case forming spirals round the cell.

Specimens IV. and V.

In these fossils the vegetable structure has not been sufficiently well preserved to permit of any safe determination.

[No. 171 of the Geological Survey Publications.]

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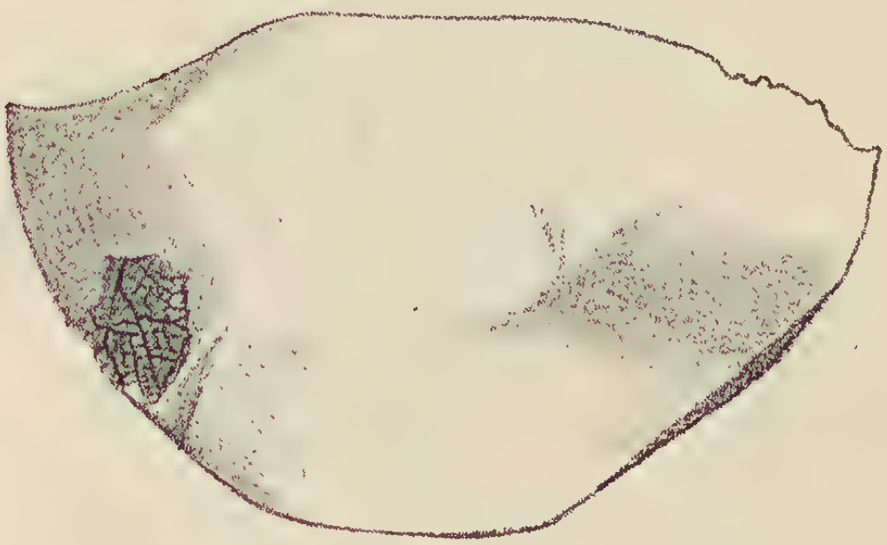

(Natural Size)

(Enlarged-showing venation.)

Ficus subgoeppcrti, sp. nov.

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Palissya? gracilis, sp. nov.

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(Natural Size)

(Enlarged two diameters.)

Cycadospermum Dawsoni, sp. nov.

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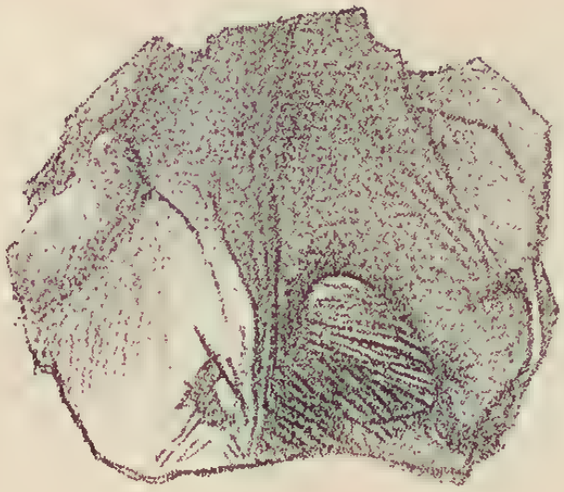

(Natural Size)

(Enlarged-showing venation.)

Nœggerathia?

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(Natural Size)

(Enlarged- showing fructification)

Mertensia (Sphenopteris) lobifolia, Morris.

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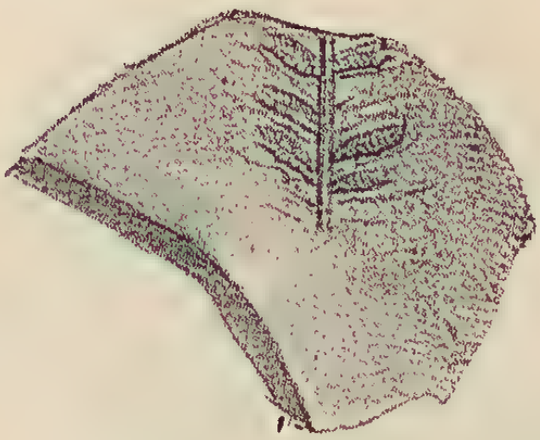

(Natural Size)

(Enlarged- showing venation.)

Pecopteris (comp.) Mantelli, Brong.

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Neuropteris punctata, Shirley.

Apex of frond.

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Oleandridium jaculi, sp. nov.

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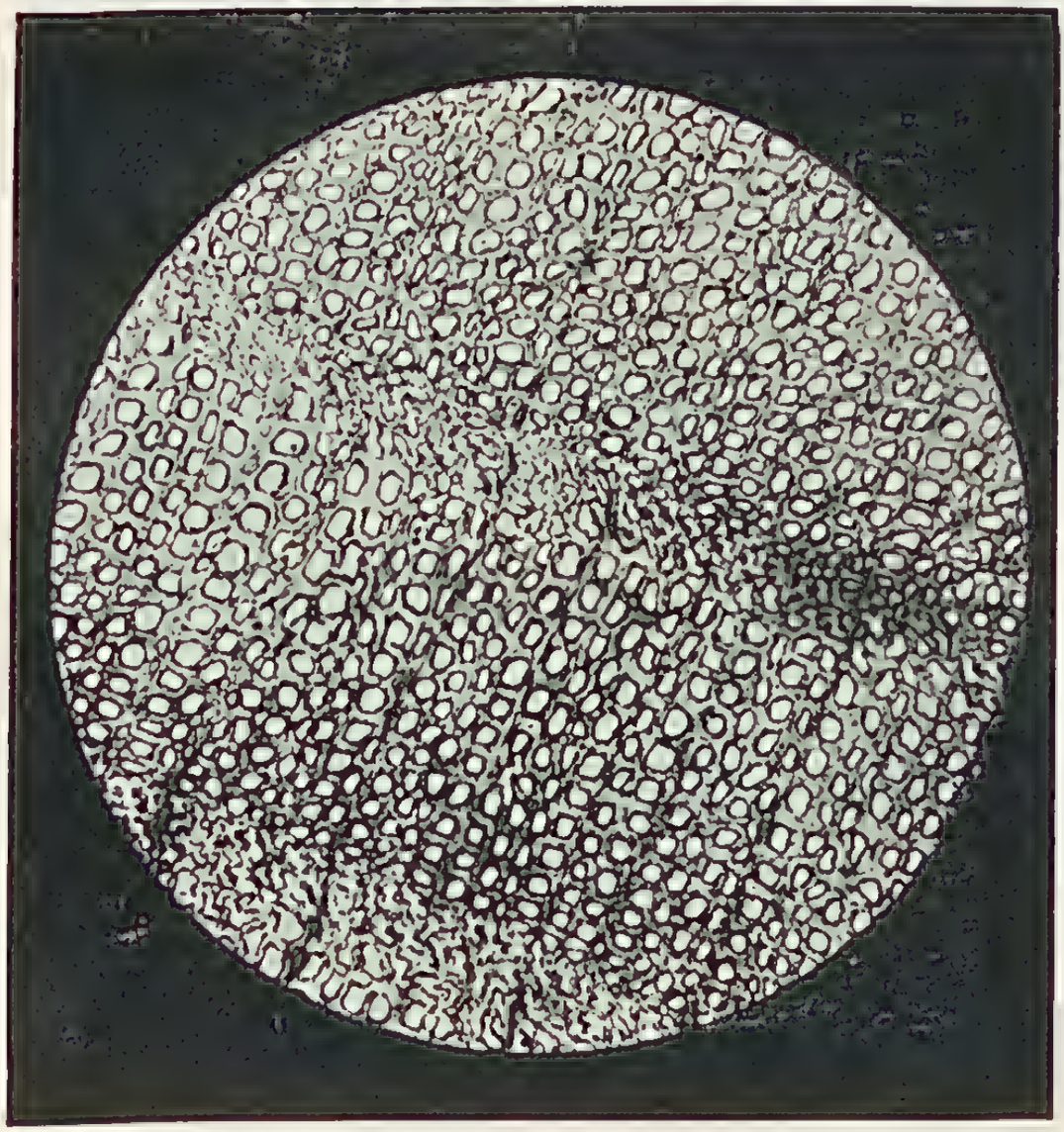


Taxoxylon Philpii, sp. nov.

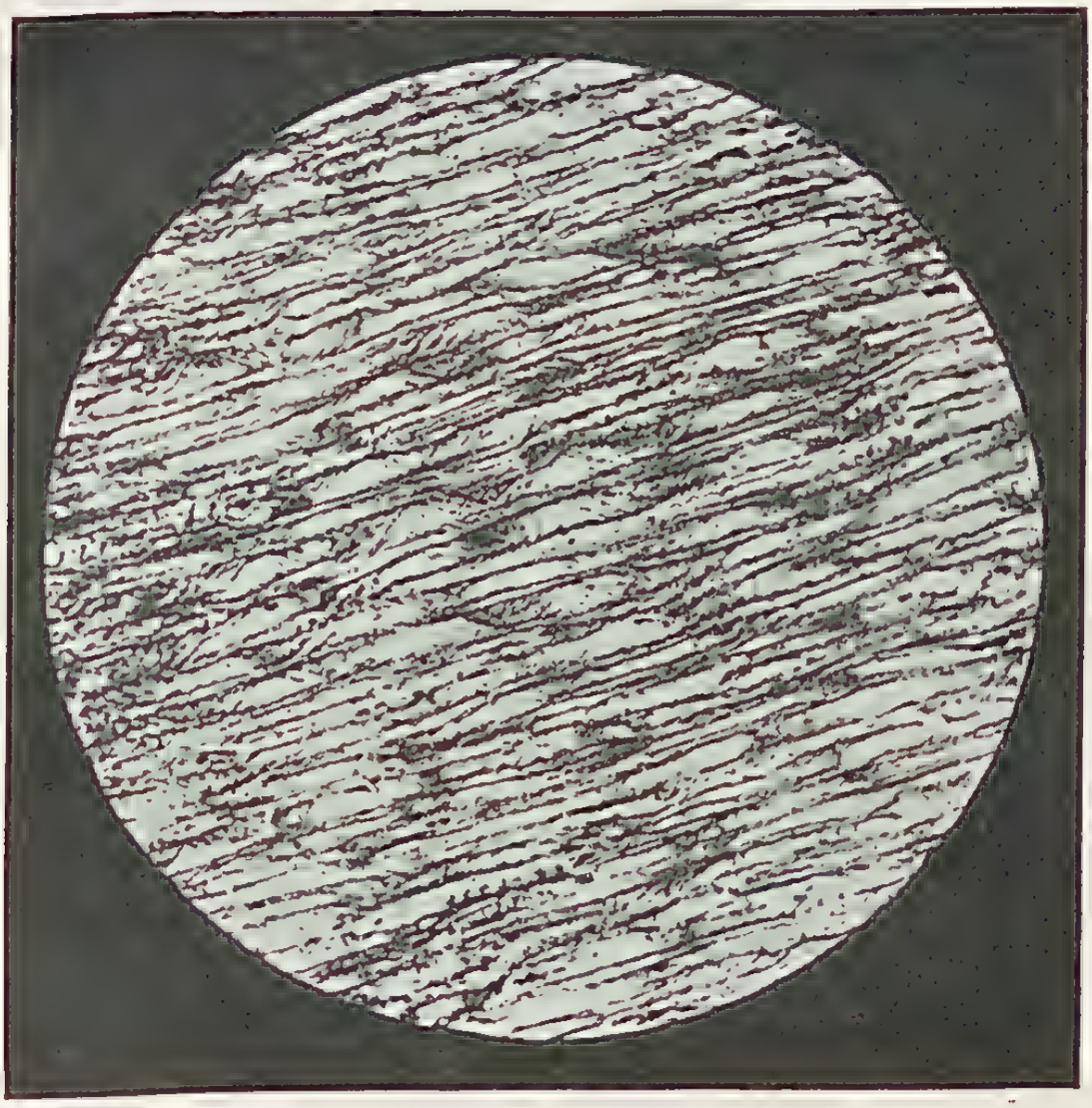
Transverse Section.

From Photo-micrographs taken by Dr. John Thomson, M.B.

Taxoxylon Philpii, sp. nov.

Longitudinal Section.

From Photo-micrographs taken by Dr. John Thomson, M.B.



Taxoxylon Philpii, sp. nov.

Tangential Section.

From Photo-micrographs taken by Dr. John Thomson, M.B.

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